PAVILAND CAVE: AN AURIGNACIAN STATION IN WALES.

(THE HUXLEY MEMORIAL LECTURE FOR 1913.)

BY

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[WITH PLATES XXI-XXIV.]

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As a temporary habitation it would be difficult to find a more excellent cave than Paviland; situated on the face of the steep limestone cliffs of Gower, it looks out over the changeful waters of the Bristol Channel; behind it is a fertile land which must have provided a rich hunting ground in early times; it is roomy, well lighted and dry, with a natural chimney to promote ventilation—serving also to carry off the smoke of a fire kindled beneath; in front of the entrance is a rocky platform with natural seats where the hunter can sun himself in the open air. Add to this that it is concealed from the landward view and difficult of access to those unfamiliar with the way. Evidently in every respect a highly "desirable" hunting lodge! How its advantages appealed to the palæolithic man of Glamorgan during the Aurignacian age is shown by the great kitchen midden which forms its floor. Here, it is plain, he fabricated his implements and weapons, here he roasted his meat, flesh of the horse, the bison, the mammoth, and the bear, and here on one solemn occasion he entombed his dead.

Chance visitors have entered it in later times, as Roman coins attest, and nearly a century ago it began to attract attention by the discovery of the remains of extinct animals in its floor. Mr. L. W. Dillwyn and Miss Talbot commenced excavations and obtained a large number of teeth and bones which were originally deposited in Miss Talbot's collection at Penrice Castle but subsequently transferred to Swansea Museum, where they now remain. News of these doings brought Buckland down from Derbyshire to carry out that admirable exploration which is described with the master's accustomed skill in the classic pages of the *Reliquiæ Diluvianæ.*[1]

Among the many facts of interest which were brought to light none approaches in importance the "Red Lady of Paviland,"—the remains of a skeleton, coloured red with iron ochre, and supposed by Buckland to have belonged to a woman.

[1] Buckland, *Reliquiæ Diluvianæ*, London, 1823, pp. 82 *et seq.*

Associated with the skeleton, and evidently, as Buckland remarks, interred along with it, were numerous objects carved out of ivory as well as a heap of little sea-shells, both shells and ivory being stained like the skeleton with red ochre.

The source of this ivory was admittedly the mammoth tusks of which remains were found in the kitchen midden, and hence it might have been supposed that the men who had fashioned it were contemporary with this extinct elephant. But this is a conclusion which Buckland refused to accept, resting his position on the

FIG. 1.—ROMAN COINS (NATURAL SIZE).

The three coins are all included within the same period (A.D. 274–306), those on the right and left belong to the time of Carausius (A.D. 287–293), the one in the middle to Constantine the Great (A.D. 274–306). The Carausius on the left bears the inscription IMP CARAVSIVS PF AVG, with the head of the emperor radiate (obverse) and a figure of Peace bearing an olive branch in the left hand and leaning on a staff on the right with the inscription PAX AVG (reverse). The Carausius on the right is not so well preserved ; the head of the emperor is radiate and the visible inscription is CARAVSIVS P(E?)AVG (obverse) ; the female figure holds a staff in the left hand and a cornucopia in the other. The Constantine shows a helmeted female head and the inscription VRBS ROMA (obverse), and the wolf suckling Romulus and Remus, with the letters TRS below and two stars above, of which one has almost entirely disappeared (reverse).

assumption that the ivory was already in a fossil state before it was worked. On a later page he cites instances of fossil ivory found in Scotland and at Bridlington which even at the present day is still "fit for the turner's use."[1] There is a British camp on the hill immediately above the cave, and since ivory bodkins are sometimes found in British barrows, Buckland was led to believe that the "Red Lady" was an ancient Briton who inhabited the cave during the Roman occupation of Wales.

The existence of "antediluvial" man in Europe was a question already ripening for discussion in Buckland's time, and Paviland Cave was rich in material which

[1] Buckland, *Reliquiæ Diluvianæ*, London, 1823, p. 179.

might have assisted in its solution. Worked flints of many kinds abound in the deposits of the floor, but curiously enough, Buckland makes mention of a single specimen only and this he compares to a strike-a-light. If, as is probable, he had before him one of the short square scrapers, of which this cave affords numerous instances, the comparison may be admitted, but it was unfortunate and misleading. We may perhaps attribute to this the fact that Buckland completed his examination of the cave without discovering its most important secret.

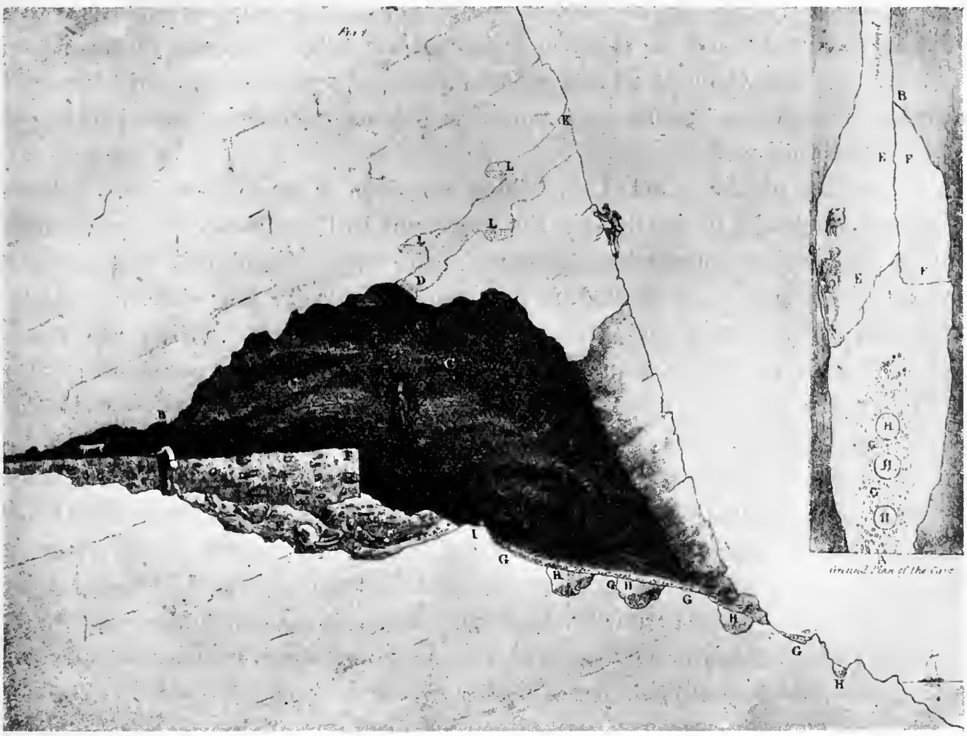


FIG. 2.—PAVILAND CAVE AS SEEN BY BUCKLAND, 1823.

A, mouth of the cave ; B, inner extremity of the cave, accessible to a dog but not to a man ; C, body of the cave ; D, chimney with ledges and hollows (L) ; E, bottom of the cave, " to which the sea water never reaches " ; F, mass of the same materials as E, but less disturbed and overhanging E in a small cliff, 5 feet high ; G, loose sea pebbles washed up during storms ; H, rock basins, produced by movement of large pebbles which still lie in them ; I, naked limestone of the floor. (After Buckland.)

When McEnery a few years later (1825), while exploring Kent's Hole, a cave much poorer in this kind of evidence, encountered flint implements along with the bones of extinct animals beneath the stalagmitic floor, he at once drew the obvious and, as it seems to us, inevitable conclusion; but in this he was possibly aided by the fact that some of these flints resembled, not a modern strike-a-light, but an ancient arrow-head.

McEnery, who was thus the first to definitely establish the existence of palæolithic cave man, at once communicated his results to Buckland. Strange to say, this acute observer, who was naturally of the most open mind—as is shown by the abandonment of his preconceived views about the deluge, directly he had become acquainted with the work of the Swiss glaciers—received them with hostility and sought refuge in impossible and almost evasive objections.

I can only attribute this to the power of preconceived ideas. Buckland, as the result of his long continued and masterly researches into "diluvial" phenomena, was convinced that man had not inhabited Europe in company with the "antediluvial" animals, and in this conclusion he was fully supported by the famous Cuvier. No one who is at all aware of the power of a prepossession will blame my illustrious predecessor; fortunate indeed is the man whose prepossessions happen always to accord with the truth.

The age of the "Red Lady" long remained a vexed question. Falconer followed Buckland in attributing the interment to Romano-British times; but to do so he had to withdraw the admission, made by Buckland, that the associated ivory objects had been carved from mammoth tusks; they were, he asserted, imported from France, and that such imports were made during the Roman occupation he proves by a quotation from Strabo, which runs as follows: "They (the Britons) pay but moderate duties on the imports . . . from Kettica, which are ivory bracelets and necklaces, amber, vessels of glass, and small wares."[1]

When, however, Lartet and Christy, fresh from Perigord, visited the remains from Paviland which Buckland had placed in the University Museum of Oxford, they at once recognized the complete correspondence of all the facts with those they had observed at Crô-Magnon. There also skeletons had been found rouged over with ochre and associated with mammoth tusks, ivory ornaments, and marine shells. In both cases, as they believed, it was the men who were contemporary with the mammoth who had made use of its ivory.[2]

This, however, was not the opinion of Professor W. Boyd Dawkins[3] who approached the question a few years later. Laying special stress on the disturbed condition of the cave deposits and on the presence of bones of sheep, he reaffirmed Buckland's conclusion but in a more general form, stating that "the interment is relatively more modern than the accumulation with extinct mammalia."

So the matter rested for nearly forty years, when (191[illegible]) M. Cartailhac being on a visit to Oxford, partly as the recipient of our honorary degree, called at the Museum and expressed a wish to see the bones of the "Red Lady." He then confided to me his belief that the interment was not only palæolithic but more precisely that it was of Aurignacian age. This led me to make a search for the ivory

[1] *The Geography of Strabo*, translated by H. C. Hamilton and W. Falconer, 1854, vol. i, p. 298.

[2] Lartet and Christy, *Reliquiæ Aquitanicæ*, London, 1863, pp. 93, 94.

[3] W. Boyd Dawkins, *Cave Hunting*, London, 1874, pp. 232–234.

implements in our collection, which I had been unable to show to M. Cartailhac,[1] and on discovering them I found their agreement with the well-known Aurignacian forms to be so exact that I had no difficulty[2] in accepting the opinion of my distinguished colleague. M. Cartailhac has since developed his views in detail; they are contained in his masterly contribution to the famous monograph on the caves of Mentone,[3] where also he enters into a full discussion of the general subject of palæolithic interments, once a burning question among Continental anthropologists. For G. de Mortillet had stoutly denied that palæolithic man paid any regard to his dead, maintaining, in opposition to M. Rivière, that the numerous interments in the Grotte des Enfants and the other caves of Mentone were all of neolithic age, and, further, that such a thing as a palæolithic interment nowhere exists. This controversy is at length happily terminated; the successive burials in the caves of Mentone are now known to have taken place in Aurignacian times, for each was found to be completely covered over by an intact layer containing hearths and an Aurignacian industry; and that interment was practised at an even still earlier period is proved by several instances, of which the most notable is that afforded by La Chapelle-aux-Saints, where a Neandertal skeleton was discovered in a Mousterian tomb.

In the summer of last year (1912) Professors Boule and Breuil, who had come to England for the purpose of investigating the alleged occurrence of flint implements at the base of the Red Crag, continued their journey to Oxford and made a careful examination of the remains in the Paviland collection. Professor Boule was much impressed with the general resemblance of the human bones to those of the Crô-Magnon race and Professor Breuil at once recognized the Aurignacian character of the ivory implements. Professor Breuil and I then agreed to visit Paviland together in search of further information. On the way we called at the Swansea Museum and found there an extremely interesting collection of flint and bone implements which had been obtained from Paviland by Colonel Wood, Mr. Vivian, and Colonel Morgan. Among them Professor Breuil identified numerous upper Aurignacian gravers and scrapers as well as some examples of early Solutrian flaking.

We then proceeded to Paviland, which is situated on the coast about 15 miles west of Swansea, but our first attempt to enter the cave was unsuccessful owing to the state of the tide and our ignorance of the approach from the landward side. The next day we were guided by Mr. John Gibbs, a farmer at Rhossili, to a path which leads down a steep valley to a recess on the right-hand side (Plate XXI, Fig. 1); it is necessary to ascend this, walk round it and descend on the other side, when all that remains is—in Buckland's words—some "dangerous climbing along the face of a nearly perpendicular cliff" (Plate XXI, Fig. 2).

[1] "Quelques ossements humains sont parvenus, sans honneur, au museum d'Oxford. Je n'ai pu savoir le sort des objets," E. Cartailhac, *Les Grottes de Grimaldi*, 1912, tom. ii, fasc. II, p. 305. For "ossements humains" we should doubtless read "objets en ivoire."

[2] W. J. Sollas, *Ancient Hunters*, London, 1911, p. 213.

[3] E. Cartailhac *tom. cit.*, pp. 304 *et seq.*

This proved not to be so difficult as it looks,[1] and at the top a scramble to the right brought us face to face with the cave (Plate XXI, Fig. 3).

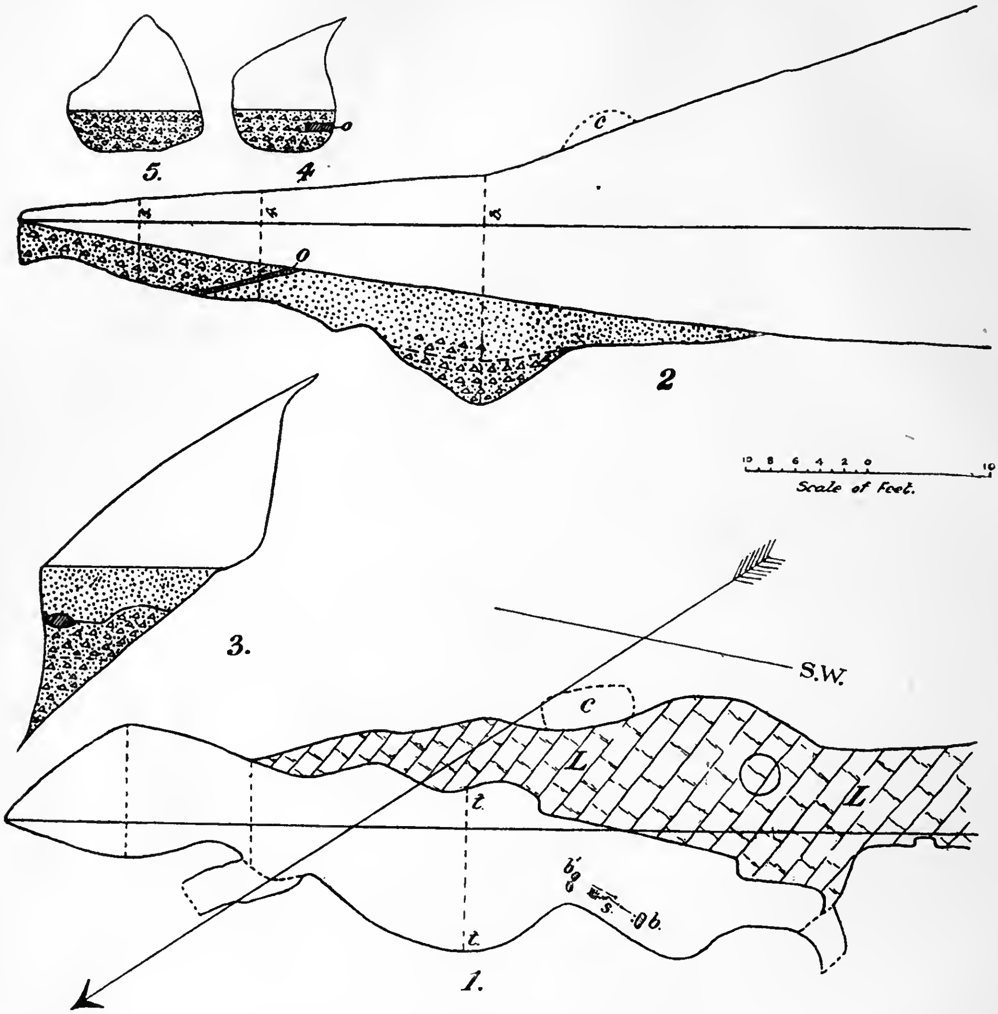


FIG. 3.—PLAN AND SECTIONS OF PAVILAND CAVE.

1. Plan of the floor: *b. b'.*, limestone boulders; *s.*, supposed position of the skeleton; *t. t.*, line of transverse trench; *L. L.*, limestone not covered with cave earth; *c.*, projected position of the chimney. 2. Longitudinal section: *o.*, band of ochreous clay. 3, 4, 5. Transverse sections taken at positions indicated by lines bearing corresponding numbers in 2. Horizontal and vertical scale the same.

We were struck with the change that had taken place, since Buckland's visit, in the aspect of the floor. The cliff, which he describes as cut into the cave deposits, 5 feet high and running longitudinally up the middle of the cave, had disappeared, and a smooth, pebbly surface swept uniformly like a beach with a

[1] Later, during our systematic exploration of the cave, the climb was made several times by a lady, Mrs. Cunnington, under the guidance of her son. The expert climber will find a really dangerous way back from the cave by continuing past it to the west till he reaches a deep gully; the ascent of the cliff at this point is possible and interesting. I have to thank Mr. Cunnington for showing me the way up.

rapidly rising slope from the entrance to the extremity. It was evident that during exceptional storms the sea had free access to the cave.

We commenced to dig and the Abbé soon obtained several Aurignacian implements, including a Gravette point and some doubtful Mousterian flakes, from no great depth below the surface. From his observations it was clear that the cave still contained much interesting matter and I was urged by Professor Breuil to undertake its exploration with the view of writing a full account of this Aurignacian station—the earliest discovered in Britain. I consented to do so, though reluctantly, for it seemed to me that Professor Breuil, the virtual creator of the Aurignacian system, was the proper person to perform this task. I was encouraged, however, by his promise to examine the spoils, a promise which he has fulfilled most generously: all the flint implements we discovered have passed through his hands, and it is by him that they have been named and classified.

Permission to dig having been obtained from Miss Talbot, who owns the cave, I invited and received the co-operation of the Cardiff Museum in the work of exploration. The Museum was ably represented by Mr. Arthur Loveridge, who was present on the spot during the whole time the excavations were in progress. My friends, Dr. Marett and Mr. Henry Balfour, gave invaluable aid as volunteers, so, too, did Mr. Ward, of New College, a university blue who proved a mighty man with the spade. My assistant, Mr. C. J. Bayzand, was our photographer and is responsible for all the illustrations of this lecture. We were extremely fortunate in our workmen, Harry Long and Jack Gibbs, who entered fully into our plans, and watched for specimens with eagle eye; very little that was of value was allowed to escape their hands.

Our first step was to construct a plan. This (Fig. 3, 1) shows how the cave, which is 70 feet in length, runs fairly straight into the cliff in a direction which is slightly south of south-west. The sides are undulating and give passage here and there to tributary channels: many pocket-like holes and crevices open at about a man's height, and as similar holes were often used by the palæolithic hunters to store their most treasured implements, these were ransacked by Dr. Marett, every one, but in vain. Along an irregular line crossing from the western to the eastern side of the cave the limestone is seen emerging from below the cave deposits to form the eastern half of the floor.

In the longitudinal section (Fig. 3, 2) the floor of cave earth is seen to rise from the entrance towards the blind end with a uniform slope of 3 in 20. How great a change has taken place since Buckland's time will be seen by reference to his section (Fig. 2), which represents the remains of the original floor as possessing a horizontal surface and ending on one side in a vertical cliff.

Of the transverse sections that given in Fig. 3, 3 is especially instructive, it shows how the form of the cave has been determined by two sets of master joints, one dipping at about 45°, the other more nearly vertical: they cross the strike of the carboniferous limestone almost at right angles. The sea has played a large part in the work of excavation, probably at a time corresponding with the

formation of the raised beaches which are found along the coast at heights of from 25 to 40 or even 50 feet above the existing sea-level.

Subsequent to the formation of the raised beaches the sea-level must have fallen considerably, probably at least 120 feet, as supposed by Prestwich.

It was during this period of emergence that the cave was inhabited by man.

Still later the sea again rose and—possibly after some slight oscillations—rested at its present limits.

Whether these movements occurred during an interglacial episode or were wholly post-glacial is an open question. Eminent observers, particularly Tiddeman and Strahan, have asserted that a part at least of the cave deposits met with along the coast of Gower are older than the glacial drift of the district. The succession of littoral deposits along the coast of Gower is as follows:—

Glacial bed, gravelly boulder clay.
Head, a talus of angular limestone fragments.
Blown sand, more or less cemented into hard rock.
Raised beach with erratics and modern marine shells.

The superposition of the boulder clay has been established by Mr. Tiddeman's observations: nothing has yet been discovered to suggest that these are in error. Mr. E. E. L. Dixon[1] admits that in Caldey Island the glacial deposits appear to overlie the raised beach, though the section there is obscure; and more recently Mr. A. L. Leach[2] has described an exposure at Porth Clais in N.W. Pembrokeshire, which supplies the strongest possible confirmation. The boulder clay is there seen to sweep right over the head and the raised beach on to a rocky platform with a glaciated surface (Fig. 4).

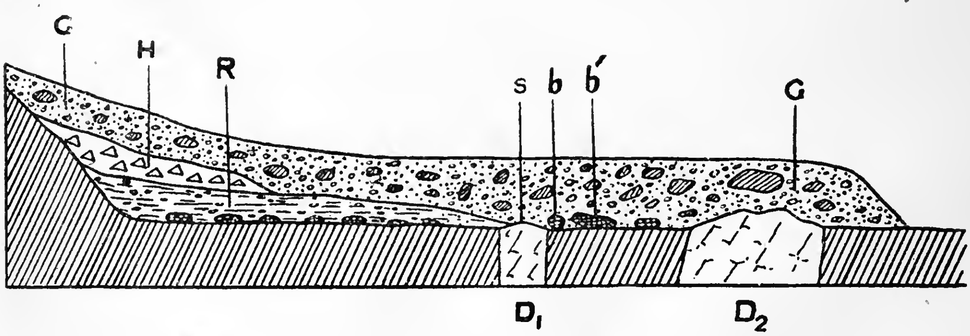


FIG. 4.—DIAGRAMMATIC SECTION OF THE RAISED BEACH AND BOULDER CLAY NEAR PORTH CLAIS, ST. DAVID'S. (After A. L. Leach.)

R, stratified shingle and boulders of the raised beach; H, head; G, boulder clay; D_1, D_2, intrusive dykes; s, the surface of D, is striated; b b′, striated boulders derived from the raised beach.

[1] E. E. L. Dixon, "Summary of Progress for 1906," *Mem. Geol. Survey*, p. 63.

[2] A. L. Leach, "On the Relation of the Glacial Drift to the Raised Beach near Porth Clais, St. David's," *Geol. Mag.*, 1911, vol. viii, p. 462.

The raised beach of Gower is the local representative of a widely distributed feature, which is found on both sides of the English Channel and elsewhere. In many places it contains at the base large erratics which are generally admitted to have been deposited by floating ice, and thus to indicate an earlier glacial episode (Riss) than that of the boulder clay (Würm).

We may infer that when the raised beach was in process of formation the caves of Gower were occupied by the sea, and consistently with this we find in some of them (Bacon Hole and Mitchin Hole) a deposit of sand, containing marine littoral shells, which lies immediately upon the rocky floor, and is covered over by whatever other deposits may be present. To correlate this marine sand with the raised beach seems only reasonable, but if we take this step it would then seem to follow that the succeeding contents of the caves are older than the culmination of the last glacial episode (Würm) and younger than the last but one (Riss).

This conclusion is in accordance with the chronology of the upper and middle palæolithic industries which I had already suggested in 1911,[1] and it is in general agreement with the views of Penck and Brückner. There is, at least, one doubtful point, however, in my scheme: I have placed the Chellean on the remote side of the third glacial episode; whether this is its true position or not will depend upon the result of a renewed examination of the bouchers found at Biddenham and Hoxne. If these should all prove to be Acheulean my chronology may stand, but if, as is most likely, some of them should be Chellean, then it is clear that this industry would have to shift its position into the last genial episode (Riss—Würm).

In a courageous attempt to reduce to order the raised beaches and other quaternary deposits which occur along the south coast of England, Wales, and Ireland, Mr. Henry Dewey[2] has arrived at some interesting results, which will be best understood from the following table. I may venture, however, to point out

Climate.	Industry.	Deposits of the South Coast.	The Valley of the Somme.
Arctic	—	Boulder clay	—
Advancing cold ...	Mousterian ...	Combe rock and head	Upper löss.
Cold ?	Acheulean ...	—	Lower löss.
Warm temperate	Chellean ...	Cemented sands and cave sands...	30-metre terrace.
	Strepyan ...		
Retreating cold ...	—	Erratics of raised beach	—
Arctic	—	—	—

[1] W. J. Sollas, *Ancient Hunters*, p. 404.

[2] Henry Dewey, "The Raised Beach of North Devon," *Geol. Mag.*, N.S., Dec., V, vol. x, pp. 154–163, 1913.

that the correlation of the upper löss with the Combe rock and head is doubtful, even improbable; and, again, the Aurignacian and Solutrian industries, and perhaps the Magdalenian, in addition to the Mousterian, should be assigned to this deposit.

The nearest approach to a standard succession of Quaternary deposits and industries is that of St. Acheul, which has been established by the painstaking genius of M. Commont.[1] It is of as fundamental importance to the study of palæolithic history as Lapworth's classic section at Dobb's Lynn is to the study of Ordovician geology. I give it here in a generalized form :—

Recent.

Azilian.

Magdalenian.

Quaternary.

Upper Löss IV. Glacial episode (Würm).	Ergeron, weathered... ...	Solutrian	Cold fauna.
	„	Aurignacian, Upper ...	„
	Gravels	„ Middle ...	„
	Ergeron	—	
	Gravels	Mousterian, Upper ...	„
	Ergeron	—	
	Gravels, angular	Mousterian, Lower ...	„
End of the third genial episode.	Stratified sands and gravels (at Montières-les-Amiens).	„ Lowest[2] ...	Warm fauna.
Lower Löss	Löss	Acheulean, Upper ...	Temperate fauna (Oscillation ?).
	„	„ Lower ...	Warm fauna.
Third genial episode.	Gravels	„ „ ...	„
	Gravels of low terrace ...	Chellean, Upper ...	„
	Sands on river gravel of second terrace.	„ Lower ...	„
	Gravels at base of second and third terraces.	Strepyan...	Fauna with Pliocene affinities at Abbeville.

The löss of the Rhine corresponds in all its subdivisions with the löss of the Somme, and it presents a lower löss with a warm fauna which is succeeded by an upper löss with a cold fauna. But the löss of the Rhine can be traced up the valley till it is brought into intimate relations with the glacial deposits of the Alps, thus, according to M. Commont, providing us with good grounds for assigning its higher member to the last glacial and its lower member to the last genial episode.

But the age of the löss is one of the most vexed questions in Quaternary history. According to Professor Haug[3] the two sheets of löss in the Rhine Valley

[1] V. Commont, "Chronologie et stratigraphie des industries protohistoriques, néolithiques et paléolithique dans les dépôts holocènes et pleistocènes du nord de la France,' *Congrès Internat. d'Anthropologie*, C.R., Geneva, 1912, pp. 239–254.

[2] V. Commont, "Moustérien à faune chaude dans la vallée de la Somme à Montières-lès-Amiens," *tom. cit.*, pp. 291–300.

[3] E. Haug, *Traité le Géologie*, Paris, 1911, tom. ii, 1815.

lie one upon the fluvio-glacial deposits of the last (Würm) and the other on those of the penultimate (Riss) glaciation. If this be so it is evident that the whole of the upper palæolithic deposits with their industries and fauna are later than the last boulder clay or glacial drift; a conclusion which is directly opposed to the results of Mr. Tiddeman's observations made on the coast of Gower. The problem, therefore, remains unsolved. It would be useless to discuss it: what is really wanted is further observation in the field.[1]

As we shall learn later, Paviland Cave itself has furnished us with the fauna and industry of the upper löss only, but in some other caves of the coast, Mitchin Hole and Bacon Hole, the warm fauna, represented by *Elephas antiquus* and *Rhinoceros hemitœchus*, was found by Falconer, unmixed with the cold fauna, in the lower part of the cave deposits. In two other instances, however, Spritsail Tor and Long Hole, the two faunas occurred mixed together; at the same time Falconer expressly mentions that in Spritsail Tor the molars of *E. primigenius* usually "present a much fresher appearance and contain more animal matter than those of *E. antiquus*."

On a review of these observations it would seem probable that Paviland Cave was excavated before the great glaciation of the British isles; it may, judging from analogy with other caves along the coast, have been entered by the sea during the formation of the raised beach, but its occupation by man was confined within the limits of the last glacial episode, possibly following upon the deposition of the glacial drift during the climax of the cold conditions.

We may now proceed to give an account of our exploration. The first step was to obtain a transverse section of the deposits by cutting a trench across the floor of the cave, 30 feet from the entrance and 8 feet in depth. The face of the cutting was found, however, to be so badly illuminated that observation was impossible, so we proceeded to clear away the material in front which excluded the light. While doing so we came across a large limestone boulder, a rough parallelopipedon in shape, but so large and unlike any we had seen before that the workmen at once exclaimed a "monument!" It lay between two and three feet below the surface and measured 1 foot 10 inches in length, 10 inches in breadth and height at one end and 6 inches at other. A little later, about 6 feet further away from the entrance and on the same level we found two others, not quite so large. In the earth between and round about them we found plentiful traces of ochre and many fragments of ivory, including bits of ivory rods such as Buckland discovered in the vicinity of the "Red Lady." From Buckland's plan of the cave it is evident that this skeleton must have been somewhere near; it is represented as extended with its long axis nearly parallel to the left (west) wall of the cave and its feet towards the entrance. It seems, therefore, extremely likely

[1] The question, in the case of the Rhine valley, depends on the identification of Professor Steinmann's middle terrace of the lower Rhine. Dr. L. van Werveke and others regard it as the equivalent of the lower terrace of the upper Rhine, Professors Penck and Brückner as the equivalent of the upper terrace.

that the boulders had been placed in position—one at the feet and two at the head of the corpse—at the time of interment; at the same time it is difficult to understand, if this were the case, how they came to escape the keen-sighted observation of Buckland.

In the course of this excavation we obtained a considerable number of flint implements and bones of extinct mammalia: the bones were almost all broken and many of them burnt and blackened: all were irregularly scattered through the deposit without any trace of order or arrangement. The earth being now cleared away it was possible to examine the face of the trench. The result was disappointing. The implement-bearing deposit—a reddish-brown earth crowded with angular and rounded fragments of limestone which extended down to a depth of from 4 to 5 feet—had evidently been much disturbed: nowhere was any trace of a definite industrial layer to be seen the hearths had been broken up and their contents distributed pell mell. This accords with Buckland's statement that the floor had been already dug over before his visit; a similar observation was made by Falconer.

Below this layer is a barren cave earth full of limestone fragments which extends to the rocky floor, attaining in one place a depth of 14 feet. At a depth of 7 or 8 feet from the original surface of the floor, part of the lower jaw of some kind of deer was seen projecting from it and we imagined that this might indicate the existence of an industrial layer, but on subsequent excavation this proved a vain hope.

The barren ground was marked off from the implement-bearing deposit by an irregular greyish white band which might perhaps have resulted from weathering, and on the western side of the cutting this was succeeded by a thin layer of well washed pebbles resting on a dark sand about 6 inches thick which was speckled white with comminuted sea-shells and precisely resembled the sea sand now driven in times of storm over the limestone ledges in front of the cave. The layer of pebbles thickened out towards the wall of the cave and on reaching the wall descended in a vertical sheet.

The restriction of these exceptional deposits to the western side of the section, which in Buckland's time was exposed at the foot of the longitudinal cliff (Fig. 2), led me to suppose that they might be explained on the supposition that the sea, entering the cave during storms, had first cut out a narrow fissure in the cave earth next the wall of the cave and that this was then filled with pebbles; continuing its work it enlarged the fissure, forming successive cliffs till the state of affairs described by Buckland was reached. Since then the planing down of the cliff would have led to the covering up of any deposits left by the sea.

The implement-bearing deposit was removed in successive layers and no signs of stratification were met with till we had advanced to within 23 feet of the inner end of the cave, when we again came across a band vividly coloured with red ochre and comparatively rich in clay; this extended from the eastern wall only half-way across the cave; sloping backwards and downwards it reached the rocky floor and

disappeared at a distance of 8 feet from its outcrop. This was the most marked line of separation we encountered anywhere, but it does not seem to have had any significance since the same kinds of implements were found both above and below it.

THE STONE IMPLEMENTS.

For so small a cave Paviland proved remarkably rich in worked flint and chert. In our excavations over 3,600 flakes and fragments were found, and of these some 700 or 800 are implements. Many had previously been extracted by other visitors, several hundred flakes and fragments are preserved in the Swansea Museum, and I owe to the kindness of Mr. Cunnington an interesting series of 50 implements. Our richest finds were made at the inner end of the cave where the deposits had been less disturbed than elsewhere.

The material.—The flint, all derived originally from the Chalk, is of many kinds, owing probably to its having been collected from the adjacent glacial drift, in which stones scattered over a wide area have been swept together by the movement of the ancient ice. But if this explanation should prove to be correct it becomes clear that the Aurignacian people cannot have inhabited the cave till after the maximum of the last glacial episode.

A common variety of the flint is translucent and honey-yellow in colour, it weathers readily; another, rather common, is black, and a third, rather rare, is grey. The specific gravity ranges from 2·57 to 2·61, as determined in different specimens; in one and the same specimen it is extremely uniform. The flint often contains patches of opaque material, grey in colour, without lustre, and of comparatively coarse texture; this is very resistant to the action of the weather and is never patinated; its specific gravity is 2·6.

Some of the chert also is Cretaceous, its original home being the Upper Greensand; it usually contains glauconite grains and weathers white.

The greater part, however, is Carboniferous, and comes from the Carboniferous limestone. This is usually black, rarely lustrous, and scarcely ever patinated. In thin slices under the microscope the black colour is found to be due to diffused transparent brown material, doubtless carbonaceous.

Some of the Carboniferous chert is grey or greenish grey; one variety is without colour and remarkably translucent. The grey flint is sometimes dotted through with minute white spots.

The specific gravity of the Carboniferous chert ranges from 2·6 to 2·67. Under the microscope it presents the same granular crystalline structure as flint, but different varieties differ greatly in texture, some being remarkably coarse. The specific gravity and resistance to weathering combine to show that the Carboniferous chert is composed almost entirely of quartz. The white spots mentioned above are granular aggregates of an undetermined mineral which has a very high refractive index and strong double refraction.

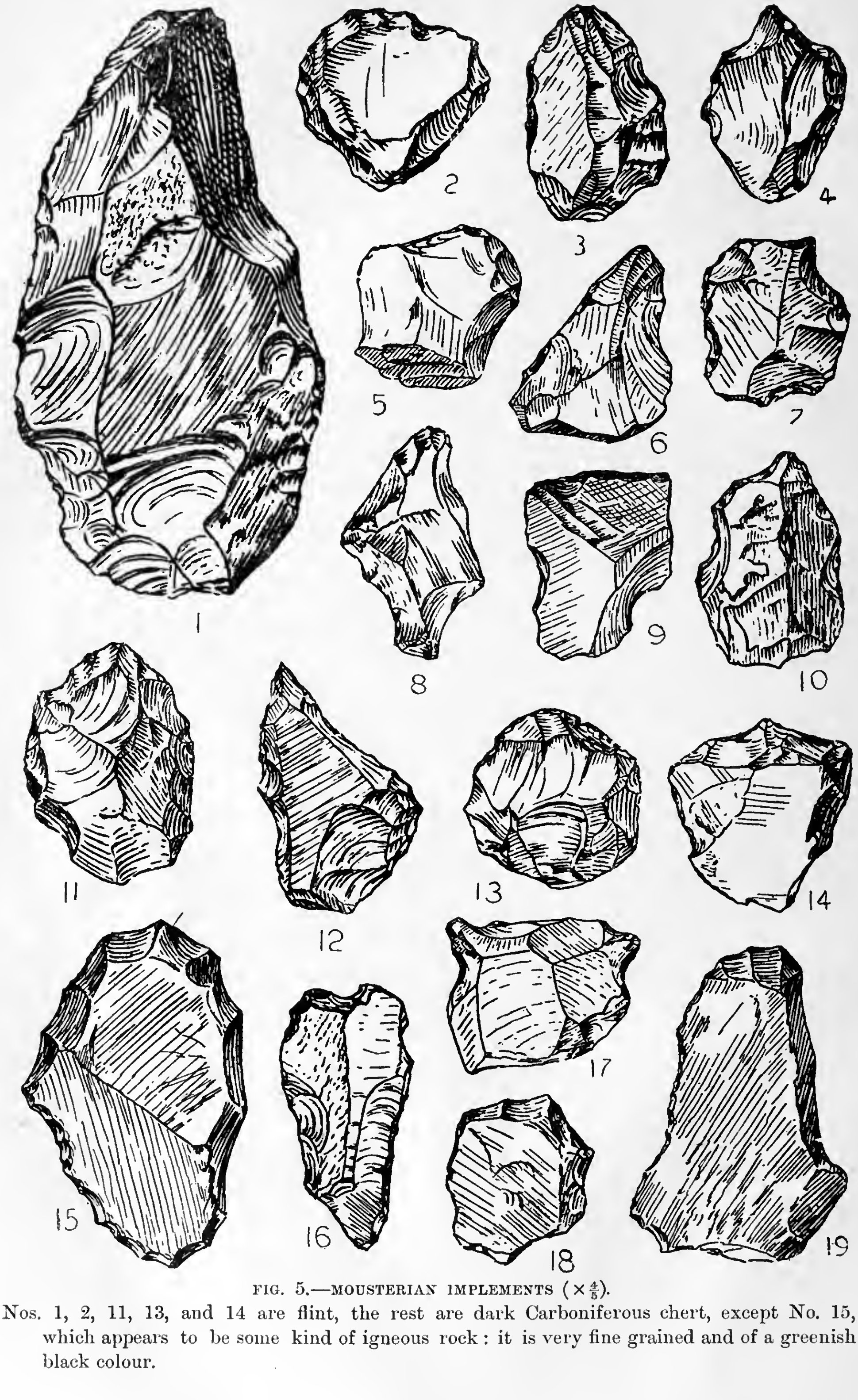


FIG. 5.—MOUSTERIAN IMPLEMENTS ($\times \frac{4}{5}$).

Nos. 1, 2, 11, 13, and 14 are flint, the rest are dark Carboniferous chert, except No. 15, which appears to be some kind of igneous rock: it is very fine grained and of a greenish black colour.

Relative Age.

The only direct and trustworthy evidence of the relative age of the cave implements is the order of succession of the industrial layers in which they occur. But as we have seen, our excavations failed to reveal the existence even of any industrial layers and consequently our classification of the implements rests solely on their morphological characters. It will be understood therefore that an implement which is assigned say to the Mousterian class is not necessarily of Mousterian age. Indeed it may be added as an independent statement that implements of Mousterian workmanship are well known to occur in Lower Aurignacian deposits; as one among several instances we may cite the deposits of La Coimba-del-Bouïtou, so admirably investigated by the Abbés Bardon and Bouyssonie.[1]

On the other hand we must not press our disclaimer too far; the order of the successive industries with their characteristic implements having been sufficiently established by observation in France, Belgium, and Germany, the form of the implements becomes a guide to the succession in those cases where this cannot otherwise be discovered. The characteristic implements thus afford precisely the same assistance here as characteristic fossils in geology; and all the implements classified as Aurignacian may confidently be accepted as belonging to that age: indeed, we may go further still, for though we cannot certainly assign each individual Aurignacian implement to its special horizon, yet we can, on the evidence of a group of these implements, definitely assert the existence of certain subdivisions, such as the Middle and Upper Aurignacian.

Mousterian.

The cave afforded numerous examples of Mousterian implements both in flint and chert, more especially in chert of the black variety. The flaking is generally rude and characterized by the removal of rather thick scales, which are short and broad. The forms, though often irregular, include a great number of varieties, some of which seem to be precursors of the more finished Aurignacian implements.[2] They may be grouped as follows:—

1. A rather large ovate flint flake, with a plain face below, retaining the bulb of percussion; the upper surface, which preserves some of the crust, boldly flaked, and the edges serrated by minute Mousterian retouches (Fig. 5, No. 1).

2. Large, fairly thick racloirs,[3] trimmed all round and carefully retouched

[1] L. Bardon, A. and J. Bouyssonie, "Station préhistorique de la Coimba-del-Bouïtou, près Brive" (Corrèze), *Bull. Soc. sci. hist. et arch. de Corrèze*, 1907–1908, 54 pp.

[2] The number and variety of the Mousterian implements is so considerable and their patina, according to the Abbé Breuil, so distinctive that I am inclined to think a Mousterian horizon must originally have been present.

[3] I have tried in vain to find simple English equivalents for the French "grattoir" and "racloir"; "scraper," without qualification, has too wide a meaning, and "scratcher" and "rasper" are inappropriate; I have, therefore, retained the French terms, which are now sufficiently familiar to English anthropologists. "Scraper," however, may be used as a general term.

along one edge. The bulb of percussion is generally removed (Fig. 5, Nos. 2, 15; Fig. 6, No. 20).

3. Rough, rather thick, biconvex lenticular or disciform bodies (Fig. 5, Nos. 5, 13), occurring both in flint and chert. Their purpose is obscure; for want of a better explanation they are sometimes spoken of as sling stones.
4. Small thick irregular forms, generally rudely flaked all over, often terminating at both ends in a rude point (Fig. 5, No. 10). These are very numerous, especially in black chert.
5. Thick but more regular forms than the preceding, flaked all over, trimmed along both sides and ending in front in a point (Fig. 5, Nos. 11, 12).
6. Straight-edged grattoirs, with abrupt flaking at the scraping end (Fig. 6, No. 23).

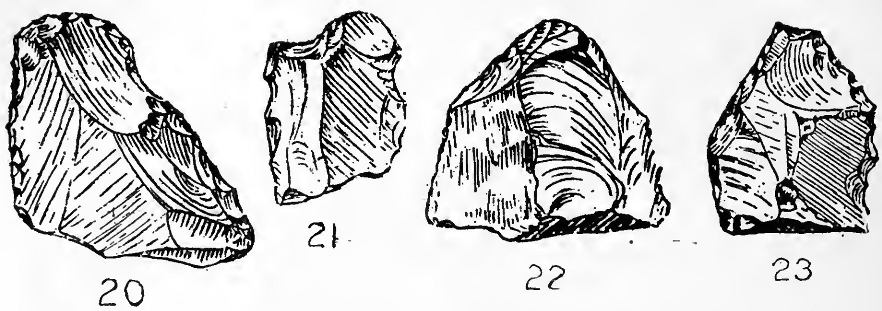


FIG. 6.—MOUSTERIAN IMPLEMENTS ($\times \frac{4}{5}$).
(These are all in black chert.)

7. Straight-edged grattoirs, with one or more concave notches (Fig. 5, No. 9). These pass into the next variety (No. 8).
8. Rostrate grattoirs, sometimes resembling the Aurignacian implement of the same name (Fig. 6, No. 21), sometimes with the beak more fully developed (Fig. 5, Nos. 6, 8).
9. Short scrapers, not thick, with concave notches which when they occur side by side give rise to points, such as might be used for scratching or boring (Fig. 5, No. 7). It may be observed, however, that in this as in many similar cases it is the concave notch which shows most evidence of wear and tear. In one instance (Fig. 5, No. 17) we have a scraper with two of these points.
10. Various forms of racloir (Fig. 5, Nos. 3, 16, 18; Fig. 6, No. 22).

PSEUDO-MOUSTERIAN.

The implements included under this term closely resemble the Mousterian but bear traces of Aurignacian workmanship and may be referred to that age. Of the numerous examples in our collection we may especially mention the following:—

1. *Racloirs.*—Thin flakes often resembling in general form the Mousterian

point, with minute marginal retouches, producing a finely serrated edge (Fig. 7, Nos. 27, 30); some of these flakes bear a positive bulb on one side and a negative bulb on the other, showing they were not the first to be struck off the nucleus (Fig. 7, No. 31): some are abruptly retouched over a part of the periphery (Fig. 7, No. 26).

2. *Simple grattoirs.*—Short thick flakes with a straight edge.
3. *Rostrate grattoirs.*—Boldly flaked into form with lamellar flaking on the snout and a well-marked anterior notch. Sometimes abruptly flaked at the base.

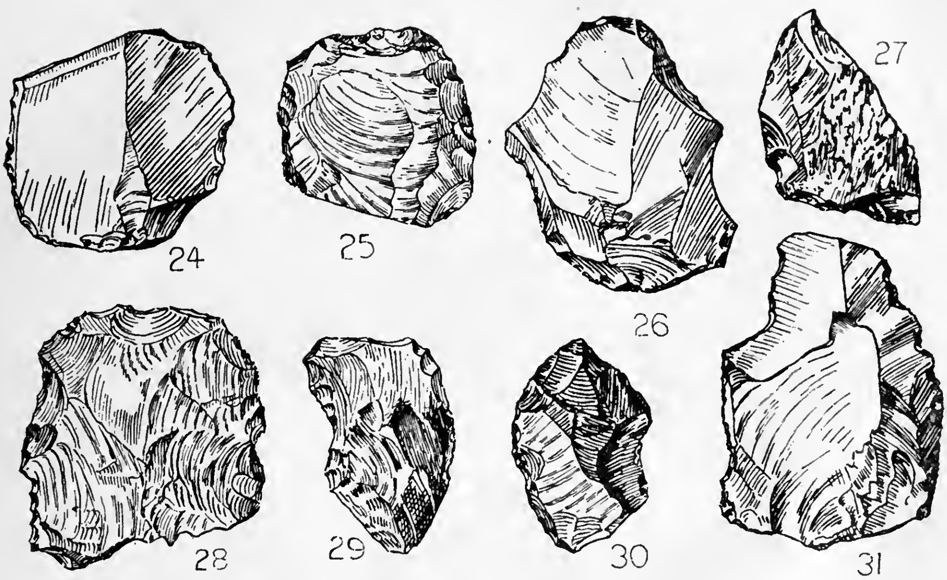


FIG. 7.—PSEUDO-MOUSTERIAN IMPLEMENTS ($\times \frac{4}{5}$).
(These are all in flint.)

4. *Universal tool.*—A flake of medium thickness ending in a grattoir at one extremity and a point at the other, with a convex edge retouched to form a racloir on one side and a concave edge retouched to form a concave scraper on the other (Fig. 7, No. 29).
5. Large fragments of flakes remarkably uniform in thickness and with equally remarkable flat scaly flaking over the whole surface; this flaking is as tangential as the Solutrian but never gives rise to long narrow channels (Fig. 7, Nos. 25, 28).

AURIGNACIAN.

The implements of this age, here as everywhere, are distinguished by a rich variety of form. Such a multifarious equipment of tools implies that the workman exercised his skill in many different handicrafts. The worked bone and ivory to

be described later support this inference, they show that the Aurignacian hunter was already familiar with the principle of the saw, the graver, the spokeshave, racloir, grattoir, and drill; but much of his work was accomplished on perishable material, and he probably produced a whole host of objects—spears, bows and arrows, digging sticks, thongs of hide, fur garments, basket work and nets—of which no trace has been or could be preserved. For some of his implements we are unable to assign a use.

The oldest of the Aurignacian implements from Paviland are:—

1. A variety of the carinate grattoir. The typical *grattoir caréné* or *grattoir Tarté* is thick and short, with a flat surface below, and a regular flaking on the sides, especially in front, produced by detaching comparatively long, thin, narrow lamellæ which ran parallel or with slight convergence from below upwards. When the lower face is worked large flakes are taken off to produce a flat base. The examples represented (Fig. 8, Nos. 32, 32*a*,

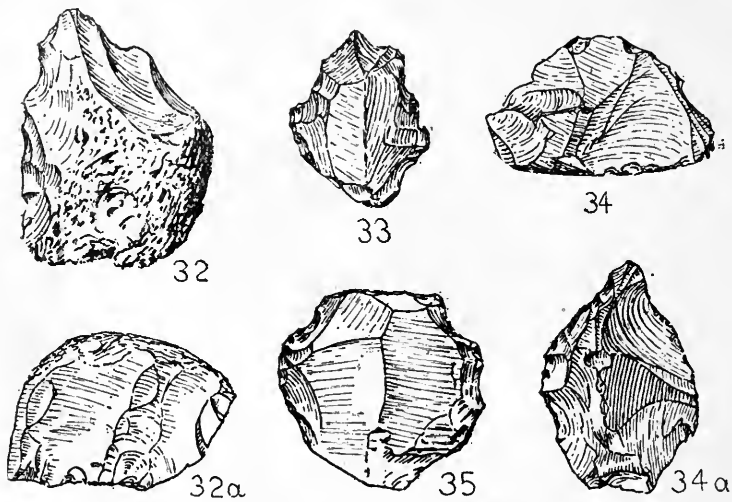


FIG. 8.—THE OLDEST AURIGNACIAN IMPLEMENTS (× ⅘).
(These are all in flint. The right-hand extremity of No. 34 is the top of No. 34*a*.)

33, 34, 34*a*) answer to this description, but are ruder in shape and less elaborately flaked than in the true grattoir caréné, to which they may have given rise, or from which they may have been derived.

2. *Nucleiform grattoir.*—This is a thick scraper related to the preceding, but not provided with a keel (Fig. 8, No. 35).

3. *Atypical racloir.*—This is a roughly chipped oval flake.

Middle Aurignacian.

The Aurignacian style of working in flint attained its fullest expression in this period: the certainty and elegance of the retouch is admirable, and the extreme

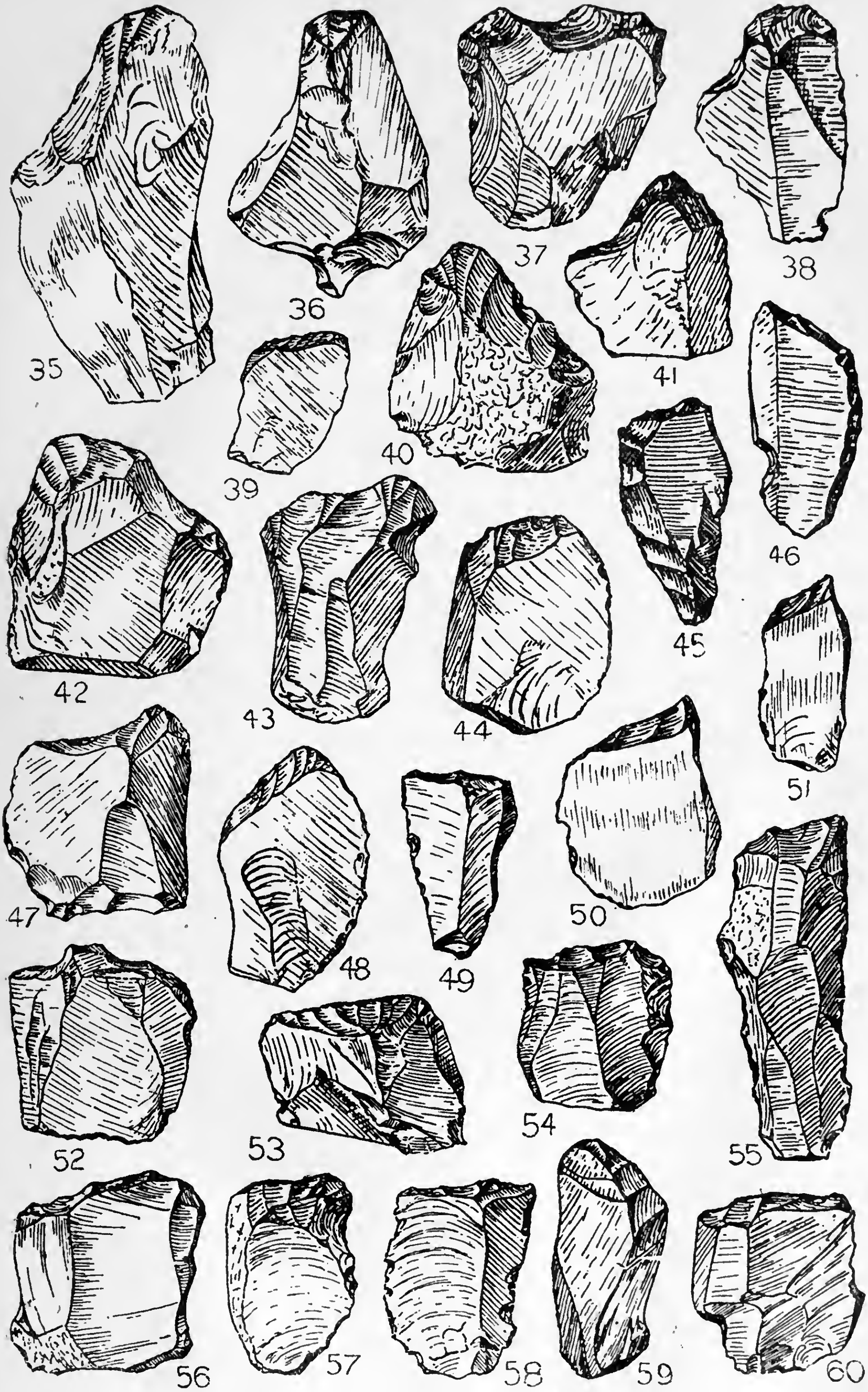


FIG. 9.—MIDDLE AURIGNACIAN IMPLEMENTS ($\times \frac{4}{5}$).
(Nos. 35, 36, 42, and 43 are in Carboniferous chert, Nos. 37 and 55 in Cretaceous chert coloured with glauconite, the remaining specimens are in flint.)

differentiation of the forms show that the workman appreciated the value of specialized tools.

1. Nucleus grattoir. This is a nucleus which, as so often happens, has been utilized as a grattoir. Similar forms occur in Neolithic deposits.
2. Straight grattoir (Fig. 9, Nos. 45, 53, 54, 58, 60; Fig. 11, Nos. 73, 74). Rather thick, generally tabular, flakes, rectangular or square, not unlike a gun flint, with wide abrupt lamellar flaking, perpendicular to the edge. Professor Breuil adds that Nos. 54, 58, 60 and 73, present a salient lateral angle which was certainly intended for a definite purpose.
3. Grattoir with oblique terminal retouches. This differs from the preceding mainly in the direction of the lamellar flaking.
4. Terminal grattoir, or grattoir at the end of the flake (*grattoir sur bout de lame*) (Fig. 9, Nos. 49, 55, and Fig. 10, Nos. 61 to 65. The scraping end may be rectilinear and oblique, with a lateral angle as in Nos. 49, 55, or curved in an arc as in Nos. 61 to 65. The flake may be a long thin lamella (No. 63), or short and thick (No. 61).
5. Straight notched grattoir (Fig. 9, Nos. 47, 52) a straight grattoir with a concave excavation at the terminal edge.
6. Rostrate grattoir (*grattoir à museau*). There are several varieties of this form; a very common one seems to be closely related to the preceding form, the terminal notch bringing into greater relief one of the corners which forms the snout or rostrum (Fig. 9, Nos. 37, 38, 40, 41, 57, and Fig. 11, No. 71).
7. Ogival rostrate grattoir. The snout is more developed, and the plan of the rostral end has the form of an ogive arc (Fig. 9, Nos. 35, 36, 42, 43). (This is a form which, so far as I remember, is rather peculiar to Paviland. It passes insensibly into another type which closely approaches a kind of burin: compare Nos. 34, 34*a*, oldest Aurignacian, and Nos. 37, 41, 44, 49, and 50, middle Aurignacian.—*Note by Professor Breuil.*)
8. Rostrate grattoir with inverse terminal retouches. The retouches are on the underside of the rostrum, and slope in the opposite direction to those on the ordinary form (Fig. 9, Nos. 39, 44, 48).
9. Short grattoir. Several varieties are included under this form. One of the most striking (Fig. 11, No. 68) is a short thin flake retaining the bulb of percussion on its plain under surface, and minutely retouched by regular oblique flaking at the front end to form a circular arc with a finely serrated cutting edge. The fine oblique flaking recalls some Solutrian and Neolithic work. I doubt whether this was intended for a scraper, it would be much more efficient as a cutting implement. Another variety (Fig. 11, No. 67) is a thicker oval flake with rather abrupt retouching all round the periphery, and a pointed extremity; a third is a short-beaked grattoir (Fig. 11, No. 70) with oblique lamellar retouches.

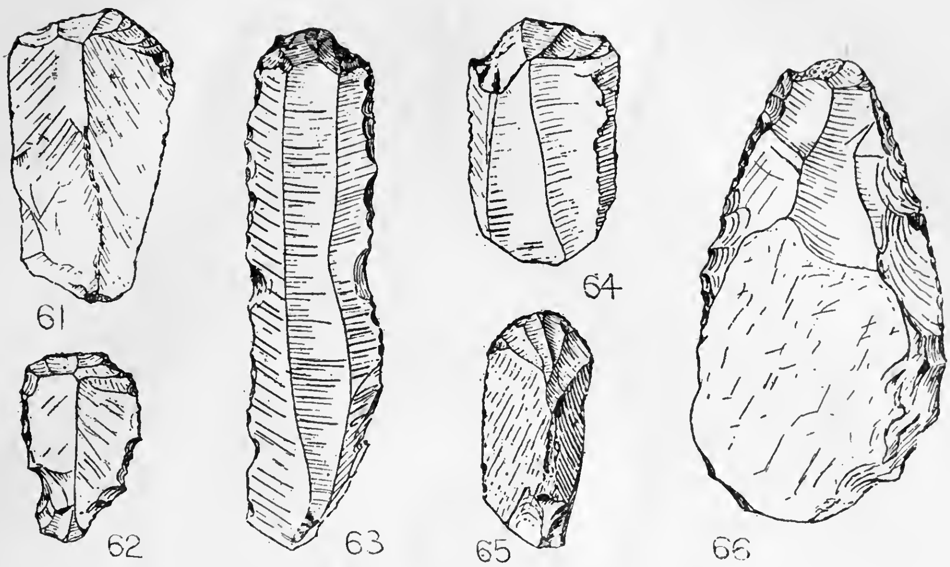


FIG. 10.—MIDDLE AURIGNACIAN IMPLEMENTS ($\times \frac{4}{5}$).
(These are all in flint.)

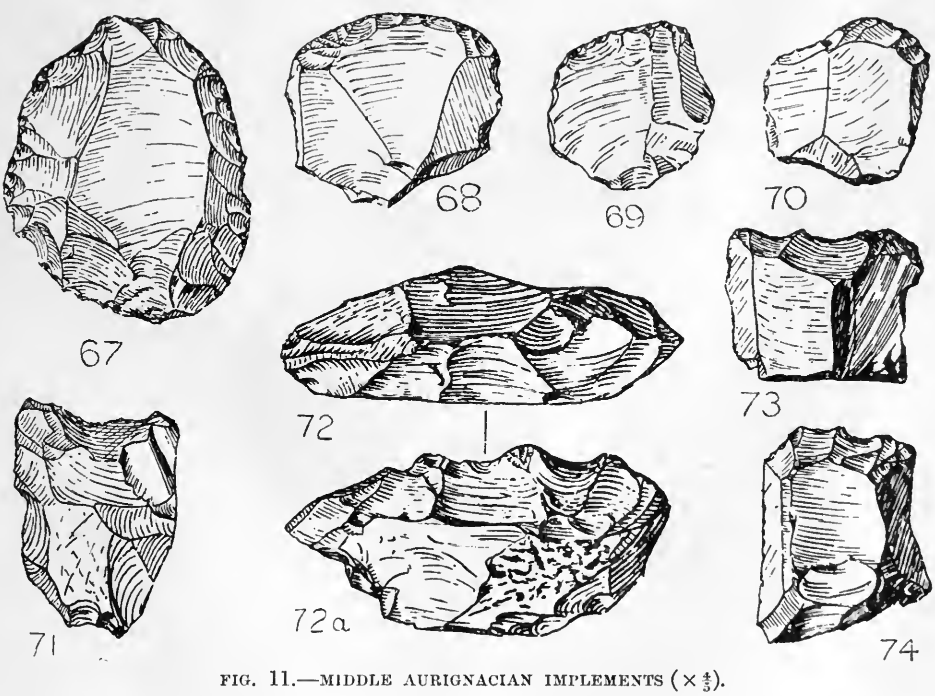


FIG. 11.—MIDDLE AURIGNACIAN IMPLEMENTS ($\times \frac{4}{5}$).
(These are all in flint, except No. 72, which is in black chert.)

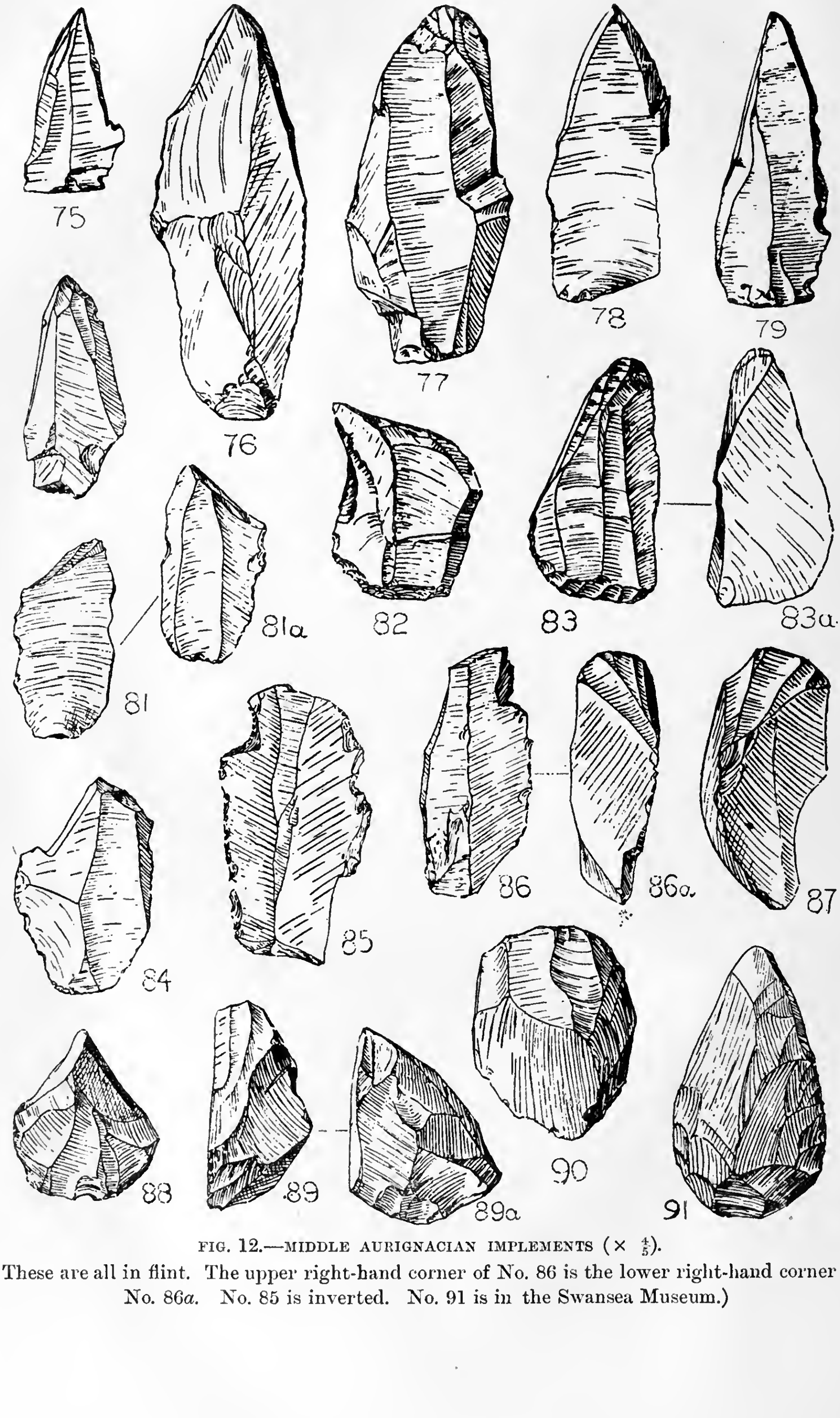


FIG. 12.—MIDDLE AURIGNACIAN IMPLEMENTS ($\times \frac{4}{5}$).
These are all in flint. The upper right-hand corner of No. 86 is the lower right-hand corner of No. 86*a*. No. 85 is inverted. No. 91 is in the Swansea Museum.)

10. Flakes with terminal inverse oblique retouch (Fig. 9, Nos. 46, 50, 51). These resemble burins, and Professor Breuil writes: "I am not sure that they are not lateral burins, Nos. 50 and 51 at all events."
11. Double racloir (Fig. 10, No. 66). Racloirs are extremely rare among our Aurignacian implements: this is one of the best examples and, as Professor Breuil remarks, it is entirely devoid of any Mousterian aspect.

One of the most characteristic implements of the later Aurignacian industry is the burin, which is distinguished by its strong, short cutting edge. It was by no means exclusively employed for engraving pictures or carving in the round,[1] but probably served a variety of purposes; it would be very useful for cutting thongs out of hides, and it was almost certainly the implement with which strips were cut out of reindeers' horn or ivory. The process in this case was to score two parallel grooves in the substance, and to deepen them till they met. The following varieties were found:—

1. Simple burin (*burin en bec de flûte*). This is the classic burin of the Magdalenian age, but it is common enough in the Aurignacian also. The edge, which is perpendicular to the plane of the lamina, is formed by two faces which meet in an acute dihedral angle. In its typical form each of these faces is simple (Fig. 12, Nos. 75, 76, 78, 79), but not infrequently one or both may be composed of several facets, and in this case the form may differ sufficiently from the simple burin to deserve a separate name; as Mr. Henry Balfour pointed out to me, it seems to have served some other purpose; perhaps we might call it a spatulate burin (Fig. 12 Nos. 77, 83, 83*a*).

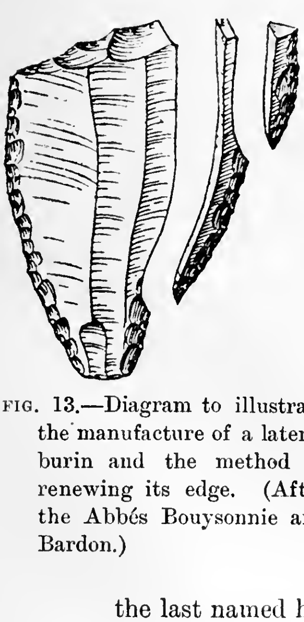


FIG. 13.—Diagram to illustrate the manufacture of a lateral burin and the method of renewing its edge. (After the Abbés Bouysonnie and Bardon.)

2. Lateral burin (*burin d'angle* or *burin laterale*). This is essentially a flake with a distal truncated end, which is more or less transversely retouched. Its sharp corner might be used for graving without further modification, but in order to strengthen the edge a spall is split off, leaving a longitudinal facet which intersects the truncated end (Fig. 12, Nos. 84, 85, 86). When the graving edge is blunted by use it can be renewed in various ways, as by taking off a second spall parallel to the first (Fig. 13) or by retouching the truncated end, or even by removing the whole of this end by a transverse fracture. All these methods were employed, but the last named had the disadvantage of unduly shortening the implement. Some specimens show by the step-like outline of the burin face that

[1] *Note by Professor Breuil.*—The burin was used for working in bone and ivory much more than for engraving.

the edge had been several times renewed. The little spalls struck off are preserved in the cave deposits and may be recognized by their form, retouching and worn edges. In some cases (Fig. 12, No. 80) a pair of notches near the base seem to have been intended for a ligature to secure the burin to a handle. (*Note by Professor Breuil.*—Nos. 80 and 82 are not very typical lateral burins.)

3. Lateral burins with inverse retouch (Fig. 12, Nos. 81, 81*a*). Professor Breuil remarks: "This is no doubt a spatulate burin, but more lateral than usual. The greater part of the spatulate and beaked burins from Paviland show a marked tendency towards inverse retouch." My friend, Mr. Miles Burkett, has called my attention to the prevalence of a similar retouch in the Aurignacian Station of La Bertonne (commune of Peujard, Gironde); it is described by M. François Daleau.[1]

4. Beaked burins (*burins busquées*). The graving end is formed by a flat facet below on one side and an arched surface with parallel lamellar flaking on the other (Fig. 12, Nos. 86, 87). The edge is renewed by flaking off the face to form a fresh flat facet. In some examples the back has been hammered down to give a comfortable grip. A specimen in black chert (Fig. 11, Nos. 72, 72*a*) recalls one figured by the Abbés Bardon and Bouyssonie,[2] from Coimba-del-Bouïtou, the chief difference being that this is single-ended while theirs is double-ended.

5. Round grattoir with opposed burin (Fig. 12, Nos. 88, 89, 89*a*, and 91). Three of these beautifully symmetrical little implements have been obtained from Paviland, one is in the Swansea Museum and the other two were found during our excavations. One end is a simple burin, the other a circular grattoir with a carefully retouched edge; the under surface is flat, the upper swollen and facetted. Similar forms have been found by the Abbés Bardon and Bouyssonie in the upper hearths of Coimba-del-Bouïtou.[3]

6. Lames or flakes variously retouched. These include forms with oblique terminal retouch, some with a notch on one side.

7. Finally, and quite atypical, are long flakes in flint and chert without retouch or definite signs of use.

Upper Aurignacian.

Many of the forms already described from the Middle Aurignacian are repeated here but they are usually distinguished by less careful retouching.

[1] F. Daleau, "Silex à retouches anormales," *Actes de la Société Archéologique de Bordeaux*, 1910, tom. xxxi., pp. 18, pls.

[2] L. Bardon, A. and J. Bouyssonie. *Loc. cit.*, p, 46, fig. 24.

[3] *ibid. Loc. cit.*, p. 49; Fig. 26, Nos. 60 and 61.

The characteristic implement of the sub-division is:—

1. The Gravette point (Fig. 14, Nos. 92 to 97. Nos. 96 and 97 are the pointed extremity broken off), a long, straight, parallel-sided flake, generally triangular in section, one edge of which has been completely removed by minute and thorough retouching. It differs from the Chatelperron point of the Lower Aurignacian, with which it may be confused,[1] by its greater straightness,

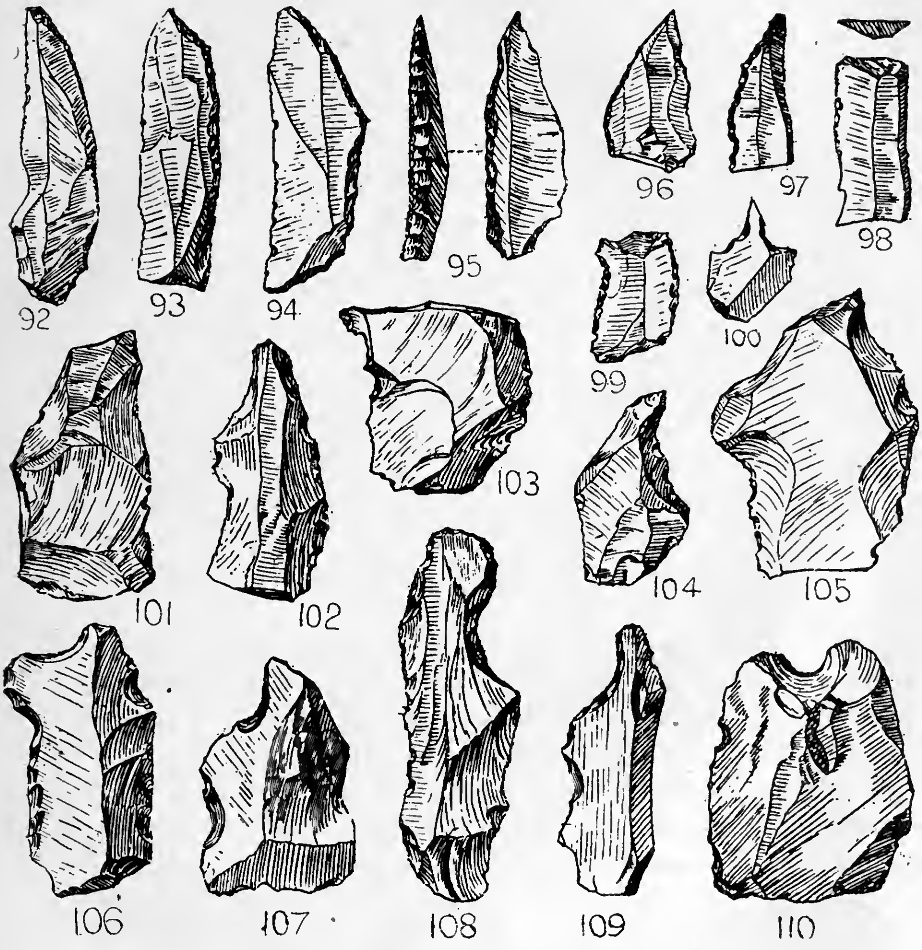


Fig. 14.—Upper Aurignacian Implements (× ½).
(Nos. 106 to 110 are in Carboniferous chert, all the others in flint.)

elongation and narrowness, as well as by its more acute point. There is a difference also in the retouch, which is more regular and finer in the Gravette point, and is almost constantly directed from below upwards. In the Chatelperron point it sometimes follows this direction, but sometimes the opposite from above downwards. (The flat of the blade is

[1] H. Breuil, "Les Subdivisions du Paléolithique supérieur et leur Signification," *Compte Rendu de la XIVe Session, Genève*, 1912, *Congrès International d'Anthropologie*, tom. I, p. 165; see in particular Fig. 1, Nos. 6 to 9.

regarded as the lower surface, the longitudinally facetted side as the upper surface.) In all our specimens the direction is from below upwards: most of them show signs of use on the cutting edge. However acute the point, and in some cases its sharpness is extreme, the retouch is always continued along the back right up to the extremity. As shown by the Abbé Breuil[1], the gravette point passes into minute forms at Font Robert (Corrèze) and this appears to be the case also at Paviland. Among the specimens collected by Dr. Cunnington is one beautiful example (Fig. 15, No. 1); small as it is, the retouch is no less perfect and is carefully maintained throughout the whole length of one side.

FIG. 15.—Minute implements or microliths (nat. size). 1. resembling a gravette point, but without a cutting edge. 2. A spokeshave or borer. Both are in flint.

The Abbé Breuil calls my attention to the tendency to assume a triangular form which is presented by Nos. 94 and 96 (Fig. 14): a point of interest, since it has also been observed at Grimaldi and in the neighbourhood of Brive.

2. Some similar little thin knife-like flakes occur but with a truncated extremity (Fig. 14, No. 98).
3. Borers (*perçoirs*).—Numerous flakes have been trimmed in such a manner as to produce one or more sharp projections, which served probably for perforating skins or boring holes in wood or ivory (Fig. 14, Nos. 100 to 105); one of these borers (No. 102) resembles a form described from the Grotte du Trilobite.
4. Spokeshaves (*coches diverses*).—A few of these notched flakes (Fig. 14, Nos. 106 to 110), resembling those from the Upper Aurignacian of the Grimaldi caves, have been chipped out of chert.[2] A microlithic form occurs in Dr. Cunnington's collection (Fig. 15, No. 2).

Numerous small flakes occur, Aurignacian in age, which could never have been retouched in their present state; they are no doubt the worn ends of burins and scrapers which have been struck off to renew the edge.

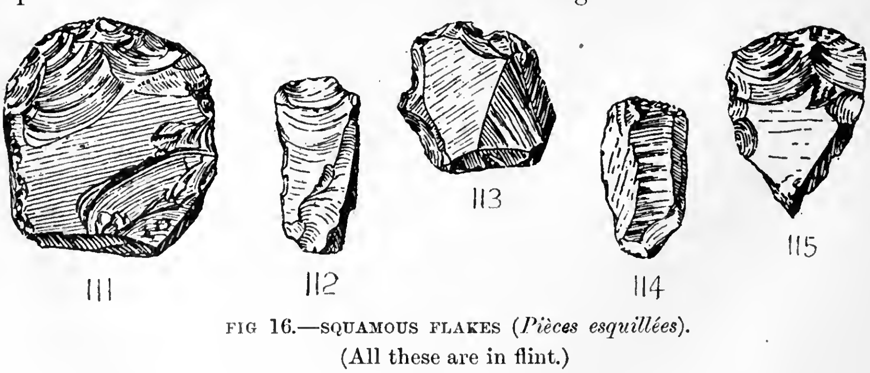


FIG 16.—SQUAMOUS FLAKES (*Pièces esquillées*).
(All these are in flint.)

[1] *Loc. cit.*, Fig. 1, Nos. 18 to 23.
[2] H. Breuil *loc. cit.*, p. 179, fig. 11 Nos. 1 and 6 to 10.

Squamous flakes.—These curious forms (Fig. 16, Nos. 111 to 115), which are found so commonly in the Aurignacian, extend upwards into the Magdalenian and Azilian. Here they are no doubt Aurignacian and probably belong to the middle subdivision. The Abbé Breuil remarks that they are instruments broken by some very violent usage which he does not understand.

Solutrian.

The approach of this age is heralded by a number of Proto-Solutrian implements distinguished by a new style and technique, markedly different from any that preceded them, but destined to a long development, which reached its highest perfection in some of the Neolithic achievements of Egypt or the still more recent triumphs of South America.

1. Tanged stylet (*pointe à soie*).—Two fragments (Fig. 17, Nos. 116, 119) represent one the tanged end (No. 116) and the other the pointed end (No. 119) of a triangular stylet; these are not unlike some forms described by the Abbés Bardon and Bouyssonie from the Grotte de la Font Robert,[1] but they are on a larger scale. The flaking is Solutrian in character but comparatively rough.
2. Laurel-leaf point (*pointe en feuille de laurier*).—This leaf-like lamina, in dark green chert, is faintly channelled on one side by thin lamellar flaking which just skims across the surface (Fig. 17, Nos. 118, 118*a*). It is keeled on the other side, and this character distinguishes it from the genuine Solutrian implement.
3. Parallel-sided point.—A well-pointed weapon (Fig. 17, No. 122), flat on one side, convex and flaked all over on the other; the proximal end is broken off. This is preserved in the collection of the Swansea Museum.
4. Razor blades.—These are triangular in section like a common razor; one side is without retouches, the other flaked all over in characteristic Solutrian style; the flakes were started from the back where it meets the side and propagated across to the cutting edge. One example is complete (Fig. 17, No. 117); another (Fig. 17, No. 115) is a fragment of a much finer blade, thinner and with surprisingly beautiful channelling; a third (Fig. 17, No. 120) is not retouched except on the back, which is crossed by channelled flaking.
5. A universal implement.—This (Fig. 17, No. 121), which at first sight seems to be merely a fragment, is a complete implement. It may be regarded as a razor blade which narrows to a dressed point at one end and expands and thickens to form a grattoir at the other.

[1] L. Bardon, A. and J. Bouyssonie, *La Grotte de la Font Robert*, Brive, 1908, Fig. 5 p. 11.

The Abbé Breuil states that the forms Nos. 115, 117, 120, and 121 are not Proto-Solutrian; this is shown by the direction of the retouch.

Hammer-stones of Upper Palæolithic age.—Among the stone implements which cannot be assigned to any particular horizon are two small pebbles, bearing the marks of use. They were selected not without judgment to serve as hammers; the material of which they consist is very hard and resistant, in one case

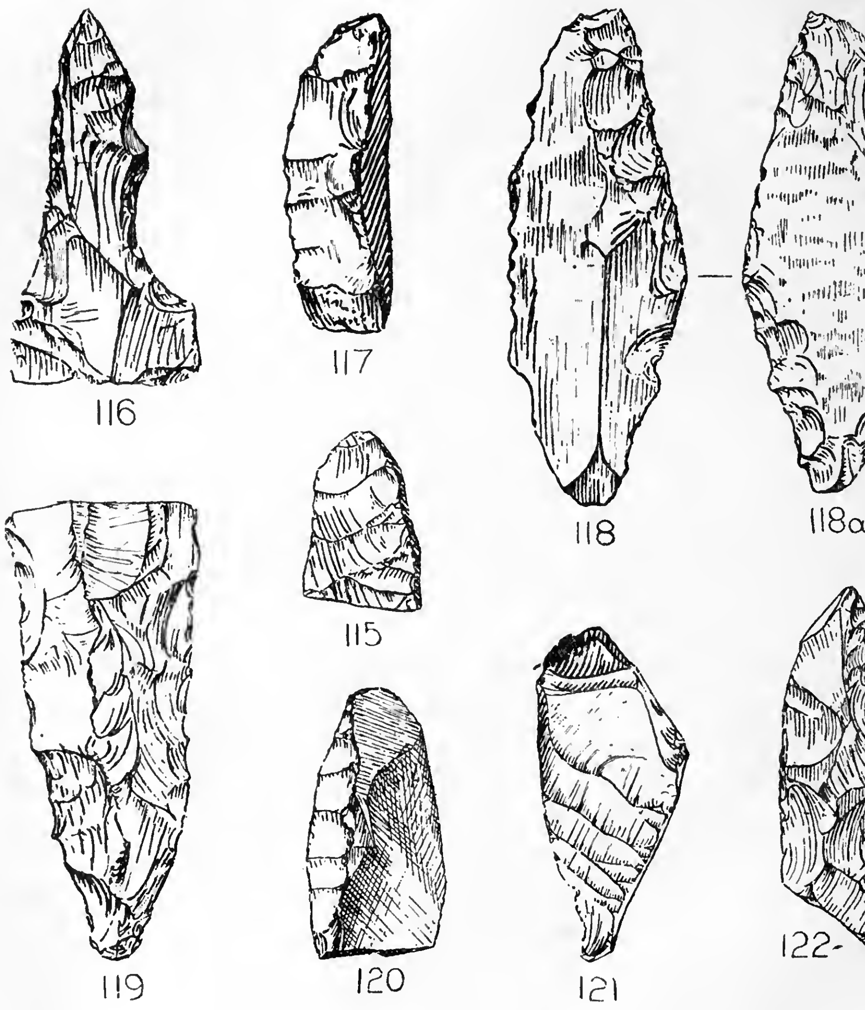


Fig. 17.—proto-solutrian implements ($\times \frac{4}{5}$).
(These are in flint, except No. 118, 118*a*, which is in dark green Carboniferous chert.)

a silicified breccia, in the other a peculiarly compact hornblende schist; their form is such as to afford an easy and firm grip as well as good striking ends, which are now much bruised by use.

In one of these specimens (Fig. 18) the rounded and bruised ends are extended in planes at right angles to each other, and there is a depression in the middle

which gives a convenient hold whichever end may be used: by simply turning it round it can be made to strike with either edge, horizontal or vertical.

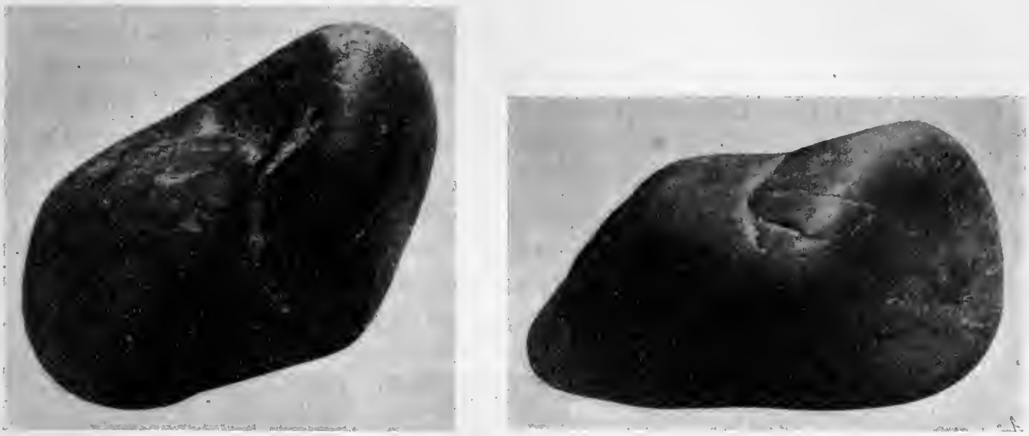


FIG. 18.—HAMMER-STONE. (NAT. SIZE.)

A hammer-stone with the edges at each end in planes at right angles to each other. One figure passes into the other by rotation about a longitudinal axis in the plane of the paper through 90°.

There is a third hammer-stone of black flint which has been chipped into shape; it is much bruised on the striking surface.

MINERALS.

The cave men were evidently not unobservant of the properties of stones and minerals. In their choice of stones for implements they were guided by expert knowledge; they knew where to look for red ochre and had already recognized its value as a pigment; but they also showed a curious interest in minerals which they could not apply to useful purposes. Thus among the minerals brought into the cave are numerous fragments of psilomelane, one weighing nearly a kilogram; a hydrate of manganese allied to pyrolusite is also present, and there are besides specimens of lignite, fibrous hematite or kidney iron ore, pseudomorphs of hematite after calcite, mammilated limonite, and a broken crystal of pure quartz. The pyrolusite might have furnished a black pigment, but not the psilomelane, which probably excited attention by its strange heaviness, as the lignite by its equally strange lightness; the iron ores were probably found in association with the red ochre and were collected as curiosities.

The quartz crystal was probably treasured for its magic powers: it recalls the practice so common among the medicine men of most existing primitive tribes, especially the Australians, of conjuring such crystals out of the bodies of their patients with the object of effecting a cure.

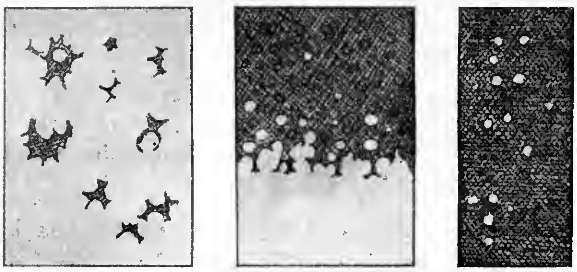
PATINATION.

We have already called attention to the remarkable dead-white patination of the flint implements, a character which they possess in common with a great number of others found elsewhere, especially in cave deposits.

The question of patination has not as yet, I believe, been so closely studied as it deserves.

The first step in the process is the removal in solution of a part of the flint from a more insoluble remainder, which is thus rendered porous. When the pores are filled with air the difference between the refractive index of this medium and the flint is so great that the incident light is scattered and absorbed. Thus the flint and its patina differ in their reaction to light in precisely the same manner as ice and snow.

It is easy to obtain very thin laminæ of flint, suitable for microscopic examination, by striking off flakes with a hammer: even flakes affording a transverse section across the flint and its patina together may be obtained in this way. If these be immersed in an alcoholic solution of some aniline dye and then well



1 2 3

FIG. 19.—PATINATION OF FLINT (×40).

The white patina is represented by the dark, cross-hatched, areas.

No. 1. Surface of a flint after digestion with concentrated ammonia solution at a temperature of about 140° C. for twenty-four hours.

No. 2. Section of flint and its patina crossing the junction of the weathered and unweathered flint.

No. 3. Surface of a flint with a "blue" patination.

washed with alcohol the weathered crust or patina will be found to retain a permanent stain and the flake, after replacing the alcohol by xylol, may be mounted in balsam for observation under the microscope. Commencing our examination at the junction of the crust with the flint (Fig. 19, No. 2) we shall see the stained material fraying off into the flint in the finest of little threads; a little further in, away from the flint, the stained material forms a close network, enclosing in its meshes the unaltered flint in the form of little globules from about 0·1 mm. to 0·05 mm. in diameter. These strongly recall the chalcedonic globules observed by Messrs. Jukes-Browne and Hill[1] which may be traced in the half-formed flint nodules of the chalk-marl through all stages of transformation from the state of opal to flint.

On finely powdering the weathered crust of our flint implements these globules may be isolated for separate examination. By applying a stain they can be shown

[1] A. J. Jukes-Browne and W. Hill, "On the Occurrence of Colloid Silica in the Lower Chalk of Berkshire and Wilts," *Quart. Journ. Geol. Soc.*, 1887, vol. xlv, pp. 403–420.

to carry with them, often coating their exterior, some of the weathered material, which in rare instances is found, by examination between crossed Nicols, to be isotropic, and, therefore, in all probability, some form of silica hydrate.

The amount of flint which may be removed in the natural process of patination is considerable. A flake which had weathered through its whole thickness, as was proved by breaking it across, was first weighed and then placed in melted paraffin till the contained air had been entirely replaced, it was next removed and allowed to cool; after cleaning the surface, to remove all adhering paraffin, it was again weighed and the difference in weight afforded a means of determining the volume of the pores which had been produced by weathering. The result in one instance was 25 per cent., in another as much as 31 per cent. of the whole flake.

The white crust is evidently a residual effect of solution but the patina is something besides. Its outermost part is an extremely thin impervious film or skin, perforated here and there by a few minute holes only. The presence of this skin may be most readily proved by breaking a weathered flake across and immersing it first in a solution of ferric chloride and then, after washing, in a dilute solution of ammonia; red ferric hydrate is at once precipitated on the fractured surface, but elsewhere, under the natural skin, the yellow ferric chloride is seen to remain unchanged, except at a few pin-holes, where a little ammonia enters and forms a slowly expanding circular area of ferric hydrate. Similarly when a fragment is placed in melted paraffin, the emission of air as the paraffin enters is confined to the pin-holes and the broken extremity.

It is to the presence of this skin that the patina owes what little lustre it possesses.

Its formation is the second step in the process of patination. The solution of silica which is formed within the crust is concentrated by evaporation at the surface, deposition follows and continues till the superficial pores are so completely obliterated that nothing can enter or leave the flint except by a few remaining apertures.

We have here much the same phenomenon as that presented by the well known "desert varnish."

The existence of a superficial layer has already been recognized by Renard and Klement[1] who speak of it as a "more compact" patina composed of crystalline silica. The inner patina is said to be opaque, the outer a colourless silica with little ramifications of the inner substance extending into it. This is not quite the same structure as that here described for I have not been able to distinguish the "skin" under the microscope, its existence can only be shown by indirect methods. Renard and Klement, on the other hand, were able to separate their superficial layer from the inner patina and to analyse it. Such a thick outer layer, sometimes more than 5 mm. in thickness, forms, however, the exterior of the weathered crust of many chalk flints, and is, of course, immensely more ancient than any patina on human implements.

[1] Renard and Klement, *Bull. Ac. roy. Belgique*, 1887 (3), xiv, p. 773.

The whiteness of the patination in our Paviland flints is conditioned, not only by the primary cause already pointed out, but also by its thickness and the absence of pigment. There are other patinas which Dr. Allen Sturge distinguishes as "blues" and "reds." The blue is obviously an incipient patination, in which the merest film of weathered material is drawn over a background of black flint. The red patinas are due to the presence of ferric oxide or hydrate: this has been denied; I therefore placed some flints bearing the red patina[1] in a solution of nitro-hydrochloric acid, this completely removed the colour, and on neutralizing the solution with ammonia, ferric hydrate was precipitated. To complete the proof the bleached flints were introduced first into a solution of ferric chloride and then of ammonia, when the original red tint was restored to the patina.

Archæologists have sometimes hoped or imagined that it might be found possible to estimate the age of an implement from the thickness of its patina, and my friend Professor Joly has even made experiments with this object. It is possible that a method may be devised which will be applicable in special cases but not, I think, universally.

Patination proceeds very slowly. We may gain some general idea of its rate by determining the thickness of the patina produced in an estimated period of time. The thickness may easily be found by breaking our implements across and measuring the white crust under the microscope (Fig. 20); observations on seventeen of our specimens gave an average of 1·36 mm. The age of the Aurignacian is unknown, but I doubt if any archæologist would regard 13,600 years as an excessive or even adequate estimate; accepting it for the sake of illustration we obtain $1{\cdot}36/13{,}600 = 0{\cdot}0001$ mm. per year as the average rate of formation. This, however, is merely an average based on thicknesses which vary over a wide range, from 4·1 to 0·15 mm. or even to zero, for there are some varieties of flint which do not weather perceptibly at all: this is particularly the case with a dense black flint which traverses the white surface of some deeply weathered specimens in a conspicuous band and does not present even a blue patination nor any loss of lustre. Thus the rate of patination depends in part on the constitution of the flint, a variable factor. It also varies with external conditions; thus it is not the same even for different sides of the same specimen, in one case, for instance, the thickness of the patina on one side is 0·3 mm., on the other 0·9 mm., in a second 0·75 mm. and 1·8 mm. Here the difference depends upon aspect; A. de Mortillet has given

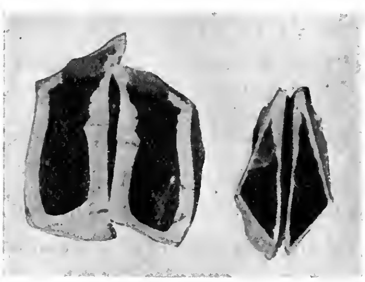


FIG. 20.—Two Aurignacian flint implements broken across to show the weathered crust, and the difference in its thickness in different examples. (Nat. size.)

[1] I have to thank Dr. Allen Sturge for these and other interesting examples of weathered flints. His views, even when we differ from them, are always stimulating and suggestive.

another example which shows how the rate is affected by the different conditions which prevail in different parts of the cave; he describes a laurel-leaf point which had been broken into four parts and scattered through the cave earth, so that when found they were lying remote from one another; they present different patinas, three of them are grey, the fourth is white and deeply weathered.

The solvent agent on which the weathering depends has not yet been identified. Water alone may produce some effect, but evidence is lacking; observations on old flint walls exposed to the rain might throw some light on the subject, but the walls would need to be very ancient. The oldest I have examined was one in Winchester College facing the rainy quarter and built A.D. 1394, or 520 years ago. In this interval weathering at the average rate already supposed would have extended inwards for 0·05 mm., and have produced a perceptible result; but considering how great a number of flints were exposed to observation we might perhaps take the maximum rate as applying to some of them and this would give a thickness of 0·15 mm., yet no trace of patination could be anywhere discerned: there was no sign of a bluish film, nothing beyond a slight loss of lustre. This would seem to suggest that water alone is inadequate to account for the whole of the phenomenon, and we are led to assume the influence of some dissolved ingredient. In the water percolating through the cave deposits calcium dihydric carbonate occurs in considerable quantity and it is not impossible that it may play the part required. The only other likely substance is ammonia. At Paviland ammonia is present in the cave earth; when digging I was often surprised at the rich ammoniacal odour which filled the air; it is evolved from the animal matter of the bones which are still in course of decomposition. The effect of ammonia on silicates may be observed on old glass windows situated over stables or on the glass of ammonia bottles in a laboratory; it is very marked and strengthens the suspicion that the patination of flints may be produced by the same reagent.

To determine this point I exposed three fragments of flint to the action of a concentrated solution of ammonia in a sealed tube which was heated to a temperature not exceeding 140° C. for 24 hours. On removal from the tube they were washed first with hydrochloric acid and then with water. After drying they were all found to have suffered some loss of lustre and one in particular had been very definitely etched. On examining this specimen under the microscope the whitened part was seen to have the form of a delicate broken network with circular meshes filled with the unaltered flint (Fig. 19, No. 1). The same kind of effect is produced by natural weathering, as may be seen by examining the surface of a flint with a blue patina in the region where the patina fades away into the unaltered part, but in this case the network is more complete and more diffuse (Fig. 19, No. 3). The appearance is indeed just such as our examination of sections of the fully weathered crust would lead us to expect, the circular areas of unaltered flint corresponding with the globules we have already mentioned. Chalcedony treated in the same way is also etched, the part attacked being interstitial to the crystalline fibres.

The experiment affords proof of corrosion, but not necessarily by ammonia,

for water alone heated up to 140° C. exerts a corrosive action on silicates. It was therefore necessary to make a control experiment, and some fragments of flint were heated in water up to this temperature for 48 hours in a sealed tube. The glass tube was corroded by this treatment, but not the flints. The experiment, however, is not decisive, since some flints yield so much more readily to solution than others.

I have also exposed freshly fractured flint to the action of a concentrated solution of ammonia for the space of six months under atmospheric conditions of temperature and pressure, but without result: a similar experiment, made with a decomposing organic solution which evolved ammonia freely, was equally fruitless.

If we wish to probe the question of patination deeper we must endeavour to obtain some clear ideas on the constitution of flint. As early as 1833 Fuchs proposed to regard flint—and chalcedony, which only differs from it by possessing a fibrous, instead of a granular structure—as a mixture of crystalline silica or quartz and colloidal, or, as he termed it, "amorphous" silica, *i.e.*, opal. Later Rose controverted this view, alleging, erroneously, that flint and chalcedony are indentical in all their most important characters with quartz. The subject was then reinvestigated by Rammelsberg, who confirmed the observations and supported the conclusions of Fuchs, but at the same time showed that the amount of silica dissolved by alkalies out of flint is far in excess of the quantity of amorphous silica which can be present in it, a result which was afterwards emphasized by Renard and Klement, who dissolved as much as 86 per cent. out of a chalk flint containing 97·5 per cent. of silica. These observers also investigated the problem with the aid of the microscope and came to the conclusion that flint consists of amorphous silica intercalated in infinitesimal particles between crystal grains, some which have the character of "chalcedony."

That one of the constituents of flint is a hydrosol of silica can, I think, admit of no doubt. It is not common opal, for that would be readily detected by staining reagents; in all probability it is some form of hyalite.

The effects of heat, long ago observed by Ehrenberg, afford decisive evidence on this point. A simple experiment is to place some thin flakes of flints in platinum foil and then expose them to the hottest part of a Bunsen flame. They do not decrepitate under this treatment, nor is any "crackling" produced, such as results when larger fragments are placed in a fire; but they completely lose their translucence and acquire a uniform dead-white colour. Chalcedony treated in the same way affords the same results. As a control experiment quartz may be calcined, it will be found to remain absolutely unaffected. The whitening is, of course, accompanied by the loss of water.

The calcined flakes may be mounted in aniseed oil and examined under the microscope; they retain their whiteness when illuminated by reflected light, but by transmitted light the whiteness gives place to brown, indicating the presence of a finely porous material like opal. Add to this the significant fact that between crossed Nicols the flake presents precisely the same crystalline granular appearance

that it had before ignition,[1] and we perceive at once that the flint must consist of two substances, one which is decomposed by heating with the liberation of water —probably hyalite, and another, which suffers no change.

It is tempting to regard this less alterable substance as quartz. A mixture consisting of one part of hyalite (having a specific gravity of 2·1 and containing 6 per cent. of water) and five parts of quartz, would have a specific gravity of 2·57 and contain 1 per cent. of water; one consisting of one part of similar hyalite and 12 parts of quartz would have a specific gravity of 2·61 and contain 0·46 per cent. of water. But the specific gravity of flint ranges from 2·57 to 2·62, and it contains about 1 per cent. of water. Such a mixture would also explain the optical characters of flint so far as they can be observed, and its remarkable solubility in alkali solutions is stated by Rose to be no greater than that of powdered quartz.

Yet I am by no means convinced that the second substance is actually quartz. Michel Lévy and Meunier Chalmas,[2] in a masterly study of the crystalline constituent of chalcedony, have shown that it differs from quartz by possessing two optic axes and a birefringence of between 0·009 and 0·01. I have repeated their observations using chalcedony which had been ignited in the blowpipe flame, and obtained similar results. I have also tried to isolate this constituent, hoping to free it from hyalite by treatment with potash or hydrofluoric acid, but none of my attempts have met with success. The effect of hydrofluoric acid on chalcedony is not so much to isolate the crystalline fibres as to corrode the zones of growth, some of which it dissolves more rapidly than others.

There is room for further investigation, but we may conclude from the foregoing that flint consists of two constituents, one a hydrosol of silica and the other a crystalline form of silicon dioxide. In the process of patination the hydrosol is first attacked, afterwards the crystalline constituent. It is possible that the latter is first hydrated and then dissolved; in any case it is so finely divided as to yield comparatively rapidly to solvents.

The Carboniferous chert differs considerably from flint, it rarely becomes patinated, and some of the purer almost colourless varieties are more coarsely grained and possess a higher specific gravity (2·65). They probably consist entirely of quartz.

IMPLEMENTS OF BONE AND IVORY.

Bits of worked ivory were turned up by the spade in great numbers, but most of them were so soft and full of water that they crumbled at a touch; some,

[1] This fact is so important that I have repeatedly heated flint flakes to the highest temperature attainable with a Herepath blowpipe, but in all cases the crystalline constituent remained unchanged.

[2] Michael Lévy and Meunier Chalmas, *Bull. Soc. Française de Minéralogie*, 1892, tom. xv, pp. 159–190, pls. These distinguished investigators have not taken sufficiently into account the influence of associated silica hydrate on some of the properties of lutécite. The same oversight has led M. F. Wallerand to make some very curious remarks on the relation of quartzine and quartz. *Op. cit.*, 1897, p. 52.

however, especially where the cave earth was comparatively dry, were better preserved, and the total number of ivory and bone objects which have been obtained by various explorers from time to time is considerable.

Rods.—Numerous fragments of the ivory rods described by Buckland as lying adjacent to the skeleton, and some found by ourselves in the same part of the cave, are preserved in the University Museum; the longest (Plate XXII, Fig. 2c) measures 99 mm. in length and 9 mm. in diameter, some of the shorter fragments are thicker (13 mm.), some thinner; all that I have seen are abruptly truncated by fracture at both ends, but Mr. H. Balfour found one fragment in Miss Talbot's collection with one end preserved: it is slightly swollen and well rounded off.

The more complete ivory rods found in Aurignacian deposits on the Continent are also, as a rule, broken off at one or both ends; some taper to a point at one end, others to a chisel edge, and these may have been used as arrow or spear points, but there are many which cannot have served this purpose, they may have been bag handles, sinew twisters, netting pins or bow drills, it is impossible to say.

Considering the implements with which they were shaped, these ivory rods are remarkably true to a cylindrical form, and the surface is often so smooth as to suggest that the final touches were given by grinding and polishing. They were worked parallel to the grain of the ivory and consequently have now a great tendency to split longitudinally (Plate XXII, Fig. 2d, 2e).

Awls.—The cave has not yielded any bone needles, which indeed are extremely rare before Magdalenian times, but several well-shaped and finely pointed bone awls have been found from time to time. One (Plate XXII, Fig. 6) is preserved in the Swansea Museum and two (Plate XXII, Figs. 7 and 9) were obtained during our excavation; one of these was unfortunately broken by accident immediately after its discovery. It is probable that the old-fashioned method of sewing with an awl, which survived in recent times among the Australians, the Indians of the North American plains, and the Bushmen, was generally practised by the Aurignacian people.

Armlet.—The fragments of an ivory armlet found by Buckland are preserved in the University Museum; their curvature on the inside corresponds with a circle 62 mm. in diameter, or about the same as an average-sized silver bangle from Ceylon. The surface is smooth; the transverse section varies in form and thickness, from point to point as shown in the illustration (Plate XXII, Fig. 12).

Some needless astonishment has been expressed at the industry and patience exercised in carving so slender a ring out of solid ivory. The ancient workman

FIG. 21.
Diagram to show how ivory rings may be obtained from an elephant's tusk.

performed no such feat. The base of the mammoth's tusk is not a solid mass but excavated for the pulp cavity in a hollow cone, and all that is necessary to obtain a ring is to make two parallel cuts with a saw across the tusk in this region (Fig. 21). To remove the edges of this ring with a hollow scraper and to smooth its surface by fine grinding would be a comparatively simple task.

Smoother.—The Paviland Collection at Oxford contains a beautiful example (Plate XXII, Fig. 1) of a class of implements which are well known under the name of "lissoirs," in the Aurignacian cave-deposits of France and Belgium.

Buckland describes this as a fragment "nearly of the size and shape of a human tongue . . . ," and continues, "its surface is smooth as if it had been applied to some use (by) which it became polished, and by which the scratches of the coarse knife from which it received its shape have been nearly obliterated." It should be pointed out that the implement is not a fragment; a few bits have been chipped off its proximal end, but otherwise it is complete. It measures 87 mm. in length by 40 mm. in breadth, 15 mm. in thickness at the base and 5 mm. at the distal extremity. On each side of the base is an oblique facet, sloping from before backwards and possibly intended to fit the implement to a handle.

FIG. 22. Spatula from Paviland Cave preserved in Miss Talbot's collection, from a drawing made by Mr. Henry Balfour. (×½.)

Marrow scoops or spatulas.—Two incomplete implements (Plate XXII, Figs. 4, 4a) carved out of a long bone (radius ?) are exhibited in the Swansea Museum, one, 124 mm. long, retains the pointed end, and the other, 142 mm. long, the handle end uninjured. A third and perfect example is preserved in Miss Talbot's collection at Penrice Castle (Fig. 22). These implements, which were possibly used as marrow scoops, afford the only instance of decorative carving from Paviland Cave.[1]

Perforated teeth.—Three canine teeth of the wolf (Plate XXII, Figs. 11a, 11b, 11c), perforated for suspension at the base, are in Swansea Museum, and two additional specimens were found by us. Besides these two perforated canines of the reindeer were identified by Mr. Henry Balfour in Miss Talbot's collection. They doubtless contributed, along with perforated shells, to form a sort of necklace, such as was commonly worn in Aurignacian times and is still in use among primitive tribes.

Truncated bear's canine.—We found in our excavation a large bear's canine, from which the cusp seems to have been sawn off so as to expose the pulp cavity. It is just possible that this might have been used as a handle, the pulp cavity serving to receive one end of a splinter of flint. Messrs. Capitan and

[1] The Abbé Breuil is inclined to think that these objects may be less ancient than the other bone implements. He points out that the bone (cetacean ?) of which they consist is not much altered, and that their form recalls some ancient Magdalenian spatulas (described in his paper, already cited, "Les Sub-divisions du Paléolithique superieur," Fig. 25, No. 4).

Peyrony[1] have described a bear's tooth from la Ferrassie, the root of which is incised all over but especially just below the enamel, and they mention a lion's canine from the Ruth bearing similar marks.

Sawn rib.—The bones obtained during our exploration were sent to Oxford; they were for the greater part in fragments, of which there were many hundreds; they weighed about 300 lbs. After washing each was separately examined for signs of carving or engraving, but without result; the most interesting object which rewarded our search was a bit of a rib about an inch long which had been sawn off the parent bone and which still retains marks of the tool. The saw was first

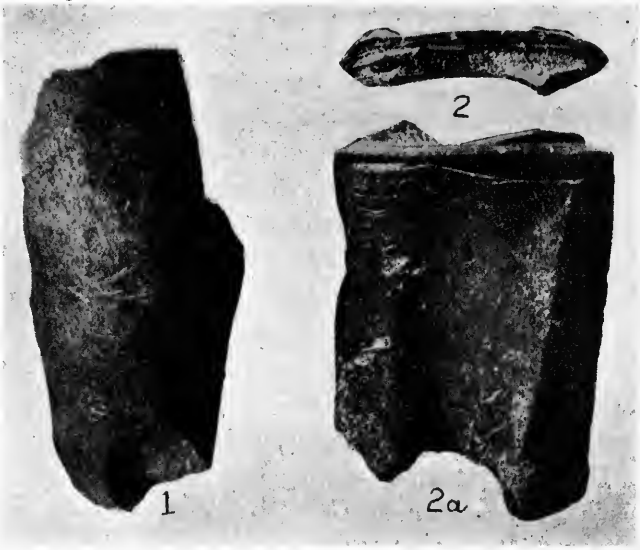


FIG. 23.

No. 1, a bone showing longitudinal striations, due to scraping, and bruised cuts at the upper end, as though it had been used for an anvil ($\times \frac{4}{5}$).

No. 2 and 2a, a fragment of a sawn rib; the sawn surface is seen "en face" in the upper part of No. 2, in 2a almost in profile; a scratch left by an erratic movement of the saw is to be seen just below it ($\times \frac{8}{5}$).

applied to the face and when it had sunk halfway through, its thickness prevented it proceeding further; attempts were then made to saw across the edges but without success, for the rib then broke across along the original notch (Fig. 23, No. 2, 2a).

Bruised bone.—We also found fragments of bones which had been scraped by flint implements, and one of these is marked with bruises (Fig. 23, No. 1), recalling those which have been observed on "compressors" from Mousterian deposits and attributed to pressure applied in the flaking of flints.

Ivory pendant.—A singular history attaches to this object (Plate XXII, Fig. 3a). In the course of his explorations Buckland found part of a mammoth tusk "in which," he says, "has been formed an irregular cavity about two inches in diameter (similar

[1] Capitan and Peyrony, "Station préhistorique de la Ferrassie," *Rev. Anthro.*, 1912, xxii, p. 96, Fig. 34.

to those effects of ossific inflammation which are produced in recent ivory by gun-shot wounds) and encircled with concentric laminæ of bony matter placed obliquely to the grain of the ivory: it is probably the effect of a blow or fracture received while this part of the tusk was yet in its pulpy state and within the socket."[1]

While our digging was in progress an incursion of the sea washed out of the cave earth a curious egg-shaped body (Plate XXII, Fig. 3a), the nature of which was not obvious to inspection. Its general form and appearance suggest a natural growth but it bears evident traces of human workmanship. At one end it is produced into a little process, evidently natural, and below this two plane surfaces have been pared away, so as to reduce its thickness as a preliminary to boring a hole through it. The boring was driven from both sides, two conical cavities being produced which meet in the middle.

The substance of this pendant looks like ivory, but it does not show the ivory grain. For further information its specific gravity was determined; it weighs 114·3 grams in air and 53·5 grams in water, its specific gravity as a whole is therefore 1·88, while that of the ivory found in the cave ranges from 2·52 to 2·83, with a mean of 2·6. This discrepancy suggested the presence of some internal cavity; some minute fragments were therefore removed and their specific gravity determined by means of a diffusion column, it was found to range from 2·52 to 2·7, the greater part having a specific gravity of 2·6. This object is therefore of the same nature as the ivory of this cave, a conclusion which a chemical examination confirms. An internal cavity is present with a volume of 16 or 17 c.c., or about one quarter of the volume of the whole (60·8 c.c.).

The outer surface is smooth and polished, but rises here and there into tubercles and tear-shaped ridges or exostoses, some of which have been planed away by a stone implement. The perforated end is stained red with iron oxide.

On puzzling over this object I concluded that it must be an osseous growth produced by a wound in the pulp cavity of a mammoth's tusk, and then on referring to Buckland's work I came across his similar explanation of an abnormal growth previously quoted. When discussing this with my friend and assistant, Miss Byrne, she informed me that the specimen described by Buckland was in the museum collection (Plate XXII, Fig. 3). We were therefore able to compare them, and found that they tallied to a nicety, the egg-shaped body obviously fitting into the cavity of the injured tusk. Thus, after the lapse of many thousands of years, we are able to bring these objects once again into their natural relations.

This curious coincidence affords additional evidence of the contemporary existence of Paviland man and the mammoth, and it shows in particular how sound Buckland was in his original judgement that the worked ivory had been obtained from the tusks of the mammoth.

As to the purpose of the pendant, which would have made an excellent plummet, we may, I think, dismiss the idea that it was used as a net sinker or for

[1] Buckland, *tom. cit.*

any mechanical purpose. The walls of the perforation are too fragile to resist any but the slightest strain. Magic powers were probably attributed to so rare and remarkable an object and it might have been suspended in the cave or slung round the neck of the hunter to bring him good luck.

COMPOSITION OF THE IVORY.

The ivory and bones of the cave earth generally retain a considerable quantity of organic matter which, on dissolving away the mineral constituents in dilute hydrochloric acid, remains behind as a transparent, fairly consistent mass.

The specific gravity of this organic residuum, as well as of the bone or ivory as a whole, can be determined on very small quantities by suspension in a diffusion column, which thus affords a simple and elegant means of discovering how far the decomposition of these substances has proceeded.

The organic matter is only slightly denser than the elastin or ossein from which it is derived; thus the fresh elastin of recent ivory has a specific gravity of 1·28, the decomposing elastin of the mammoth ivory of Paviland of 1·29.

If we attribute a specific gravity of 3 to the bone earth, which is the mineral constituent of ivory, then the composition of the ivory will be about 40 per cent. of elastin and 60 per cent. of bone earth, this ratio giving a specific gravity of 1·953 while the observed specific gravity is 1·94.

The specific gravity of Egyptian ivory from tombs of the First Dynasty, *i.e.*, 5,000 years old, is 2·4, of some of the mammoth ivory of Paviland 2·545; of *E. antiquus* ivory 2·62, and of *E. meridionalis* 2·87, and the corresponding quantities of elastin are for Egyptian ivory 20 per cent., mammoth ivory 13 per cent., *E. antiquus* ivory 10 per cent., and *E. meridionalis* 3 per cent. These results suggest the possibility of determining the age of a specimen of ivory from its specific gravity, but on repeating my observations I find variations of so large an amount that it will be necessary to make further observations.

THE SKELETON.

The famous "Red Lady" was found by Buckland on the left (west) side of the cave under 6 inches of earth, but judging from the eroded extremities of some of the bones (radius and ulna) it would seem probable that a part must have been exposed to the air and worn away by the action of water.

Nearly the whole of the left side of the skeleton was preserved, but as Buckland expressly states, the skull, vertebræ, and the extremities of the right side had disappeared. It is worth while to call attention to this statement because a belief prevails that the skull was obtained and was deposited in the University Museum but subsequently lost: so that one of the first inquiries made to a new professor of geology is "Have you found the Paviland skull?" For this legend

the diagrammatic illustration given by Buckland[1] is probably responsible, since it represents the skeleton as complete, skull and all.

The bones are said not to have been disturbed, so that this part of the cave, at least, had not been dug over before Buckland's visit; they were extended "in their natural order of contact" and included the humerus, radius, and ulna of the left arm and the bones of the left leg with the foot "entire to the extremity of the toes," as well as a part of the right foot and many ribs. These, with unimportant exceptions, are to be found in the Museum, which contains, in addition, the greater part of the right fibula, the distal extremity of the right tibia, and a fragment of the left scapula; but of ribs there are only four fragments, and some of the bones of the left foot are missing.

Buckland notes the curious fact that in the midst of the bones of the ankle there was a small quantity of a yellow wax-like substance resembling adipocere.

There is a remarkable parallelism between this interment and those of Mentone; here as there the body was laid out approximately parallel to the axis of the cave, with no attempt at orientation; red ochre was profusely scattered over and about it and this pigment still adheres to the bones; large stones were placed at the head and feet; and various funerary objects, such as ivory rods and ornaments, and little seashells (*Natica neritalis*) were buried along with it.

Miss Byrne found in the material from our excavation the distal end of a left humerus which differs greatly in character from that of the "Red Lady."

DESCRIPTION OF THE BONES.

For the measurements of the bones given in the following account, as well as for numerous descriptive notes, I am indebted to Mr. F. H. S. Knowles of Oriel College.

The *humerus* (Plate XXIII, Figs. 2, 3) is a comparatively slender bone and the muscular attachments are far from well marked; perhaps this may help to account for Buckland's belief that the skeleton was that of a woman. But as Mr. Knowles points out the articular head is large, the maximum diameter of the articular surface measuring 47 mm., and this points strongly to the male sex,[2] a suggestion which is strengthened by the magnitude of the head of the femur (49 mm.), and still more by the head of the tibia (76 mm.). There is thus the strongest presumption that the "Red Lady" was not a woman but a man.

[1] *Loc. cit.*, Pl. 21.

[2] G. A. Dorsey, *Boston Medical Journal*, 1897, vol. cxxxvii, p. 80. Dorsey's observations on 38 Red Indians of the north-west coast of North America showed that the diameter of the head of the humerus ranged from 39 to 43 mm. in the women and from 44 to 51 mm. in the men; of the femur from 39 to 43 mm. in the women and from 44 to 54 mm. in the men; of the tibia from 65 to 70 mm. in the women and from 72 to 86 mm. in the men. For civilized and European races the results were similar.

The dimensions of the humerus are given in the following table, which includes those of the Mentone examples for comparison:—

Humerus.	Pav.	Cav.	Enf.		B.G.1.		B.G.2.	
	L.	R.	R.	L.	R.	L.	R.	L.
Total length	338	342	369	365	374	379	354	350
Breadth of upper end	49	—	54	53	61	—	57	62
„ „ lower „	56	—	66	66	70	68	64	65
„ „ lower articular surface ...	47	—	49	47	53	47	—	—
„ at the level of the deltoid ...	20	—	27	23	33	26	20	29
Thickness in the middle	19·4	—	26	22	27	23	24	28
Index of thickness	5·9	—	7·3	6·3	8·8	6·9	5·7	8·3

Note.—In this and subsequent tables the following abbreviations are used:—*Pav.*, Paviland; *Cav.*, Grotte du Cavillon; *Enf.*, Grotte des Enfants; *B.G.*1, Grotte de la Barma Grande, 1; B.G.2, Barma Grande, 2.

The epiphyses are ossified to the shaft, but the line of demarcation is still evident and the age is therefore not much over twenty-five years.

The *ulna* (Plate XXIII, Fig. 1), of which only the proximal three-quarters is preserved, is comparatively slender, but with well-marked muscular impressions; the summit of the olecranon shows the commencement of a circular groove for the insertion of the triceps and there is a deep pit for the short supinator muscle (just below the little sigmoid cavity).

The *radius* (Plate XXIII, Fig. 1), of which also only the proximal three-quarters is preserved, is a rather slender bone and not much curved; the bicepital tubercle is large and well marked. The sagittal flattening of the shaft just below the attachment of the round pronator is much less than in the examples from Mentone. In both radius and ulna the epiphyses are ossified to the shaft, an indication that the age was above twenty years.

The *os innominatum* (Plate XXIII, Fig. 4) is described by Mr. Knowles as follows:—

"The general size and shape of this bone, the pronounced muscular attachments, the large obturator foramen, and the form of the great sacro-sciatic notch, which is narrow and longer along the inferior than the superior margin show that it belonged in all probability to a male subject. The pelvic outlet and inlet, so far as can be judged from one side alone, resemble the male rather than female type."

The *femur* (Plate XXIV, Figs. 1, 4) is a strong stout bone with pronounced muscular attachments. The *linea aspera* forms a prominent ridge; below and immediately outside its upper and outer bifurcation is a large but shallow depression which corresponds with the hypotrochanteric fossa of Dr. Houzé, it is about

60 mm. in length, and 11 mm. in breadth. This is a feature which is very characteristic of the Crô-Magnon race, though not confined to it. The lesser trochanter is prominent; but, again agreeing with the Crô-Magnon femur, there is no third trochanter; as Professor Verneau points out it is not till we enter the neolithic age that a third trochanter becomes at all frequent.

The epiphyses are ossified with the shaft, but the line of demarcation is still evident, from which we may infer that the subject was not much over twenty-five years of age.

The dimensions of the femur are as follows:—

Maximum length in the oblique position		...	476 mm.
Subtrochanteric diameter, sagittal		...	27 „
„ „ transverse		...	36 „
„ index	70·27		
Pilastric diameter, sagittal	...	...	32·5 „
„ „ transverse	...	...	27·5 „
„ index	118·18		
Popliteal diameter, sagittal	...	...	33 mm.
„ „ transverse	...	...	45 „
„ index	73·33		

It will be seen from the platymeric and popliteal indexes that the shaft presents a considerable amount of transverse flattening both above (platymery) and below. Comparison with the Crô-Magnon race may be made from the following table:—

Indices.	Pav.	Enf.		B.G.1.		B.G.2.		Men.*	Mean.†
	L.	R.	L.	R.	L.	R.	L.		
Subtrochanteric ...	70·27	77	76	69	75	54	67 ?	76	70·6
Popliteal	73·33	73	79	81	83	71 ?	83 ?	—	78·3

According to Professor Manouvrier platymery commences at 80, is well marked between 75 and 65, and very strong below 65. Thus all the Crô-Magnon femurs are obviously platymeric and the index of the Paviland femur is almost identical with the mean obtained from the Mentone examples. The popliteal flattening is more pronounced in the Paviland than in most of the Mentone femurs, but, as Professor Verneau remarks, these do not present so great a popliteal flattening as some modern Europeans.

* Men. Femur in Museum of Mentone.
† Mean for Grimaldi femurs.

The *tibia* (Plate XXIV, Fig. 2) shows the same vigorous development of the muscular attachments as the femur. Its dimensions and index are given along with those of the other Crô-Magnon in the table below tibia:—

	Pav.	Cav.	Enf.		B.G.1.		B.G.2.		Crô-M.
	L.	R.	R.	L.	R.	L.	R.	L.	
Length	398	404	448	450	436	432	402	398	—
Sagittal diameter	40	43	42	43	48	47	52	47	—
Transverse „	24	28	29·5	29	28	28	32	29	—
Index of breadth	60	65·1	70·2	67·4	58·3	59·6	61·5	61·7	63
			68·84		58·95		61·61		

The transverse flattening or platycnemia exceeds the mean (63·4) of the Mentone examples, but falls well within the series.

Professor A. Thomson calls attention to an accessory facet on the anterior side of the lower articular surface. He regards this as associated with the habit of sitting in a squatting posture; it is common among primitive races, both prehistoric and modern.

The *fibula* (Plate XXIV, Fig. 3) is 388 mm. in length. It resembles in general characters the fibula of the Crô-Magnon race, the longitudinal furrows are deep, the ridge for the insertion of the interosseous ligaments is prominent, but there is no marked torsion in the distal quarter of its length.

The *astragalus* and *calcaneum* (Plate XXIII, Figs. 5, 6) do not present any noticeable peculiarities.

The Stature of Paviland Man.

In determining the stature of Paviland man we have the choice of two methods, one that of a distinguished anatomist—Professor Manouvrier,[1] the other of a distinguished mathematician—Professor Karl Pearson.[2] The latter is becoming increasingly used in England, the former is adopted by Professor Verneau in his monograph on the Grimaldi or Mentone skeletons. We will make use of both and for the sake of comparison we will extend the application of Professor Pearson's method to Professor Verneau's material.

[1] L. Manouvrier, "La Détermination de la Taille d'après les grands os des membres," *Mémoires de la Société d'Anthropologie de Paris*, 1893, sér. 2, vol. iv, pp. 347–402.

[2] K. Pearson, "Mathematical Contributions to the Theory of Evolution. V. The Reconstruction of the Stature of Palæolithic Races," *Phil. Trans.*, 1899, vol. 192, pp. 169–244.

The lengths of the long bones which provide us with data are given in the following table:—

	Pav.	Cav.	Enf.		B.G.1.		B.G.2.		Crô-M.		Ba.
	L.	R.	R.	L.	R.	L.	R.	L.	R.	L.	
Humerus ...	338	342	369	365	374	379	354	350	322	320	363
Femur	476	470	523	522	532	526	491	—	475	—	—
Tibia	398	404	448	450	436	432	402	398	395	—	—

The statures inferred are given in the next table:—

ESTIMATED STATURE OF CRÔ-MAGNON MEN.

	Pav.	Cav.	Enf.		B.G.1.		B.G.2.		Crô-M.		Ba.
	L.	R.	R.	L.	R.	L.	R.	L.	R.	L.	
Humerus ...	1·696	1·709	1·774	1·774	1·794	1·814	1·730	1·732	1·637	1·644	1·756
Femur ...	1·714	1·703	1·802	1·800	1·819	1·807	1·742	—	1·712	—	—
Tibia ...	1·732	1·751	1·851	1·861	1·823	1·818	1·742	1·737	1·725	—	—
Fe. and Tb. (*e*)	1·732	1·732	1·842	1·845	1·839	1·830	1·752	—	1·725	—	—
" " (*f*)	1·729	1·728	1·840	1·843	1·838	1·830	1·751	—	1·724	—	—
Means of (*e*)	—	—	1·8425		1·8345		—		—		—
Manouvrier	1·735	1·74	1·89		1·88		1·77		1·716		1·80
Verneau ...	1·785	1·79	1·94		1·93		1·82		1·766		1·85

The first six lines in the table give the results obtained by Professor Pearson's formulæ; the seventh the results from M. Manouvrier's tables, as calculated by M. Verneau, except for the man of Crô-Magnon calculated by M. Rahon and of Paviland by myself, the last line gives the results obtained by adding 5 cm. to those in the seventh line, as is done by M. Verneau, who justifies this procedure by the following statement: "Je possède, à l'heure actuelle, 17 observations de sujets de grande taille dont on pu mesurer les os longs après la mort. La taille *calculée* à l'aide de ces longeurs est *toujours inferieure* à la taille prise sur le vivant. L'écart, assez variable suivant les individus, atteint en moyenne 5 centimetres."

Without this addition, however, most of the heights obtained by M. Manouvrier's formulæ are noticeably greater than those obtained by Professor Pearson's, which we

have provisionally adopted. If it should prove that we must add the 5 cm. claimed by M. Verneau, our estimates given below will be increased by 2 inches.

It will be seen that the results calculated by Professor Pearson's formulæ from the humerus are, in all instances but one, lower than those obtained from the other bones; it is the same with those based on the femur when compared with those based on the tibia. We shall discover the explanation of this when we come to consider the proportions of the limbs; and we shall be led to conclude that the values which make the most probable approach to the truth are those obtained from the femur and tibia taken together and from Professor Pearson's formula (*e*) rather than (*f*). These give us in round numbers as the mean height of the race 5 feet 10 inches, with a maximum just over 6 feet and a minimum of 5 feet 8 inches. A tall people even on this estimate, still taller if we accept M. Verneau's results, and offering in any case a striking contrast to the Neandertal men who, from Professor Pearson's calculations based on the Neandertal and Spy skeletons, attained a height of only 5 feet 3·6 inches (1616 mm.). The Chancelade man, with an Eskimo skull, has the stature of an Eskimo, 1575 mm. (Pearson) or 1592 mm. (Manouvrier), and not of a Crô-Magnon man.

Proportions.

As we learn from the investigations of M. Verneau the proportions of the limbs in the Crô-Magnon race differ notably from those of modern Europeans.

In the lower limb the length of the leg as opposed to the thigh is greater than in most existing races. The relative length of the two segments as expressed by an index (length of tibia × 100 / length of femur) is as follows:—

Barma Grande 1.	Barma Grande 2.	Paviland.	Gr. des Enfants.	Cavillon.
81·20	81·54	83·83	85·44	85·96

The mean of the Grimaldi examples is 83·53 or almost identical with the index for the Paviland man. In Europeans the index is 79·72 and in Negroes 81·33.

The unfortunate defect of the radius, which has lost its distal extremity, renders it impossible to compare the upper and lower limbs in their entirety; we are reduced, therefore, to a comparison of the femur with the humerus. Making use, as before, of an index (humerus × 100/femur) we have the following:—

Crô-Magnon.	Gr. des Enfants.		B.G.1.		Pav.	B.G.2.		Cav.
	R.	L.	R.	L.	L.	R.	L.	R.
67·79	70·56	69·92	70·3	72·05	71	72·1	—	72·77
	71·24		70·17					

The mean of the Grimaldi examples is 70·8, again almost identical with the index for the Paviland man. In modern Europeans the index is 77; thus in the Crô-Magnon race the humerus is unusually short, and this explains the discrepancy between the stature estimated from it (1·696 Paviland), and from the femur and tibia (1·732).

We have seen that the femur is shorter than usual relatively to the tibia, and this might lead us to suspect that the humerus may be shorter than usual relatively to the radius; that this is actually the case is borne out by Prof. Verneau's study of the Grimaldi skeletons.

Prof. Verneau has also shown that the ratio of the arm as a whole to the leg as a whole is less in Crô-Magnon men than in modern Europeans, though it approaches that in Negroes.

On surveying our results it is clear that the Paviland man—already shown to be of the same geological age, associated with the same fauna, and to have arrived at the same stage of industrial development, as the best-known examples of the Crô-Magnon race—presents also in all the discoverable characters of his skeleton the the same racial peculiarities. The "Red Lady of Paviland" is a Crô-Magnon man. He was a little over twenty-five years of age, tall of stature, probably a little taller than the man of Crô-Magnon itself, and about the same height as the man of Cavillon; but these three examples are the shortest yet discovered within the limits of the race. His lower limbs were longer than usual relatively to his arms, and his leg was disproportionately long compared with his thigh.

The man of Paviland represents the most westerly outpost of a race which is known to have extended to the east as far as Lautsch and Předmost in Moravia and from Belgium on the north through the Dordogne in France to the margin of the Mediterranean at Mentone.

THE FAUNA.

The fauna is such as our previous study might lead us to expect; it is characteristically upper palæolithic, and by the abundance of the horse points especially to the Aurignacian age.

I have to thank Miss Byrne of Somerville College for identifying the numerous bones which were received at Oxford, and for making a long journey to Swansea in order to study the interesting collection which is preserved there in the museum of the Philosophical Institute. The following list has been drawn up from her catalogue:—[1]

Equus caballus, very common.
Ursus spelæus, „ „
Bos primigenius, common.

[1] This last agrees on the whole with that given by Falconer (H. Falconer, *Palæontological Memoirs*, 1868, vol. ii, p. 525), who, however, mentions *Cervus elaphus*, but not *Megaceros hibernicus*, and *Bos priscus*, but not *B. primigenius*. He marks some animals as common which we find to be rare, the mammoth, for instance.

Rhinoceros tichorhinus, common.
Rangifer tarandus, „
Megaceros hibernicus, not common.
Canis lupus, „ „
Elephas primigenius, rare.
Hyæna spelæa, „

To these may be added recent bones of fox, badger, and sheep, together with one tooth of a pig. There are some recent bones of birds, and some which appear to be ancient. *Arvicola amphibia*, mentioned by Falconer, is also represented.

The majority of the bones of the Pleistocene mammalia occur as broken fragments, a fact explained by Buckland as due to the repeated diggings of explorers. This is plainly not the case, and there can be no doubt that the bones were broken by the inhabitants of the cave, for the most part with the object of extracting the marrow. Many are covered with scratches such as would be produced in scraping off the flesh with a racloir. There are, besides, some flakes and fragments of bone which have the appearance of having been used as implements, for after a thorough scraping to remove the periosteum they have been subjected to some treatment which has marked the surface with bruised cuts (p. 38).

As already observed by Buckland none of the bones have been gnawed by hyænas, and this fact, taken in conjunction with the presence of broken hyæna bones in the cave, would seem to indicate that the ancient hunters were reduced in times of scarcity to feeding on the flesh of this disgusting animal.

Our account of the Paviland Cave is now concluded. On reviewing our results derived from the industries, the skeleton, and the fauna, we shall not fail to be impressed with their consistency, both among themselves and with the conclusions of archæologists in other lands.

The hunters who found shelter in the cave were men of large stature, members of that tall Crô-Magnon race, which occupied the greater part of habitable Europe during the Aurignacian age. They were men of capacious brains, and had made great progress in such simple mechanical arts as are essential to society in its most primitive stage, when subsistence depends wholly on the natural products of the earth, chiefly on roots and fruits which it is the allotted labour of the women to collect, and next on the flesh of animals killed in the chase and contributed by the men to enliven existence by an occasional feast.

For the fine arts the sojourners in the cave seem to have had little love, they have left no recognizable drawings on ivory or bone, and the red stripes discovered by the Abbé Breuil and myself in the neighbouring cave of Bacon Hole are the only attempts at mural decoration which the race is known to have left behind in Wales. Their personal adornments were scanty, that their garments were made of prepared furs is probable, but we know nothing of their taste in dress; they

wore necklaces made of wolves' teeth and little sea-shells, as well as bracelets of mammoth's ivory, and they possibly dressed their hair with a pomatum made of fat and red ochre, a primitive but certain protection against vermin.

They doubtless exercised some magic arts, and they respected their dead sufficiently to provide them with a ceremonial burial.

Whether the Aurignacians were preceded in their occupation of the cave by the Mousterians is at least doubtful, such Mousterian implements as have been found being also known in Aurignacian deposits, nor is it certain that they were succeeded by the Solutrians, for the weapons of that war-like race, though found in the cave, prove nothing more than the advent of Solutrian influence. Of any remains which might indicate the presence of the Magdalenians there is no sign.

Since the disappearance of the Aurignacians the tide of civilization has ebbed and flowed more than once over these islands; all that it has left stranded in the cave are three copper coins to mark the Roman occupation and, for the greater glory of our own age, many broken fragments of whiskey bottles.

But the cave is not the place where the future historian will search for relics of the British Empire, and in fairness to the vanished Aurignacian hunters we must admit that the information we obtain by rummaging their kitchen midden does not exhaust their story, the best part remains untold: could we know the whole, we might have occasion to admire their ingenuity, to applaud their courage and to sympathise with their aspirations towards the ideal.

DESCRIPTION OF PLATES

PLATE XXI.

Fig. 1.—General view of the approach to the cave from the landward side. The cliff bounds on the right, a steep valley here entering the sea. It is descended by a slope leading to a triangular grassy patch, from which a path, now well trodden, is seen as a black band descending steeply to a rocky ledge. The ledge is well defined from the cliff by a chasm which is filled below by the sea.

Fig. 2.—Final part of the climb from the ledge at a point which may be identified in the first photograph by measuring 0·3 inch to it from the figure seen against the sea.

Fig. 3.—View of the cave from in front. The foremost figure is standing in the trench which was excavated across the cave in the middle of its length.

PLATE XXII.

Objects in bone and ivory from Paviland Cave.

All the figures in this plate are reduced about $\frac{2}{3}$.

Fig. 1.—Ivory smoother or lissoir. 1a, seen from above; 1b, seen edgewise, showing one of the lateral facets; 1c, lower surface.

Fig. 2.—Fragments of ivory rods found by Buckland, 2a and 2b are comparatively thick, 2c is the longest fragment preserved, 2d is split lengthwise, 2e shows the split face of another fragment.

Fig. 3.—Part of a mammoth's tusk, found by Buckland in 1821, showing an irregular cavity resulting from a wound. Fig. 3a, egg-shaped growth of ivory or dentine formed in the cavity of Fig. 3, found in 1913: it has been pared down on opposite sides at one end and perforated for suspension.

Fig. 4.—Bone spatulas or marrow scoops. Fig. 4 has lost its point and Fig. 4a its handle.

Fig. 5.—Part of an Aurignacian point with a solid base—*non fendu.*

Fig. 6.—Ivory awl.

Fig. 7.—Ivory rod tapering towards both extremities, at one of them it is split lengthwise, but there is no evidence to show whether this is by accident or intent.

Fig. 8.—Fragment of an ivory point.

Fig. 9.—Ivory awl: when found this was complete, the elongated sharp point was broken off by accident.

Fig. 10.—Fragment of an ivory plate, scored by a graver.

Fig. 11.—Wolves' teeth perforated for suspension.

Fig. 12.—Fragments of an ivory amulet placed on a circle of the same curvature: cross sections of the fragments are far from constant in form, as is shown by their outlines in the interior of the circle.

PLATE XXIII.

Bones of the "Red Lady" of Paviland.

The figures are a little less than half-size ($\times$ *about* $\frac{49}{100}$).

Fig. 1.—Proximal two-thirds of left radius and ulna.

Fig. 2.—Left humerus, posterior aspect.

Fig. 3.—Ditto, anterior aspect.

Fig. 4.—Os innominatum.

Fig. 5.—Calcaneum and metatarsals of right foot.

Fig. 6.—Calcaneum, astragalus, naviculars and cuboid, and four metatarsals of left foot.

PLATE XXIV.

Bones of the left leg of the "Red Lady" of Paviland.

A little less than half-size ($\times$ *about* $\frac{456}{1000}$).

Fig. 1.—Left femur, seen from behind.

Fig. 2.—Left tibia, from behind.

Fig. 3.—Left fibula.

Fig. 4.—Left femur, seen from in front.

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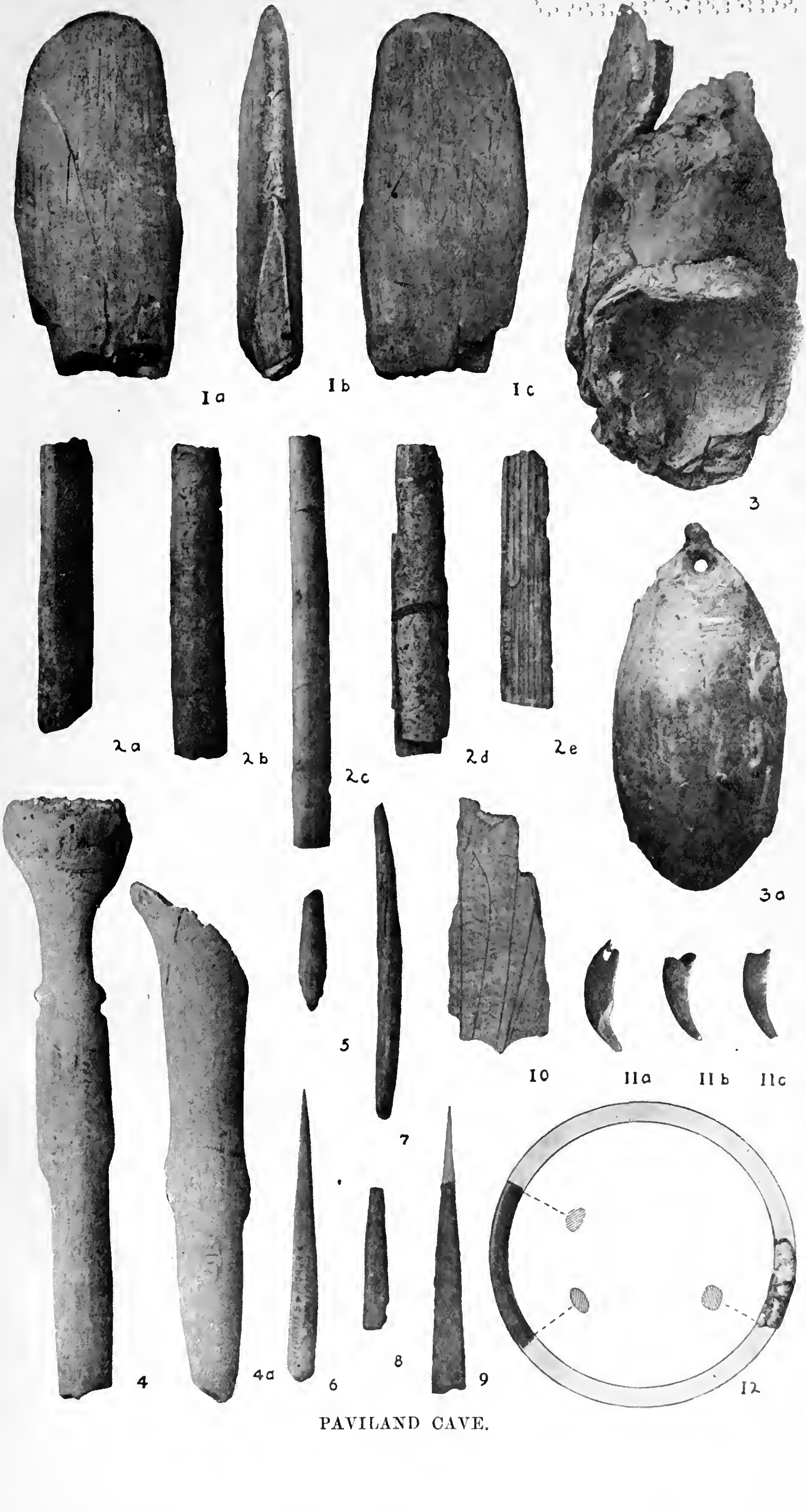
FIG. 3.

FIG. 1.

FIG. 2.

PAVILAND CAVE.



PAVILAND CAVE.

Journal of the Royal Anthropological Institute, Vol. XLIII, 1913, Plate XXIII.

1 2 4

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PAVILAND CAVE.

1 2 3 4

PAVILAND CAVE.